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OCS EIS-EA
MMS 86-0001

# PROPOSED 5-YEAR OUTER CONTINENTAL SHELF OIL AND GAS LEASING PROGRAM

## JANUARY 1987 - DECEMBER 1991

Draft
Environmental Impact Statement

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United States Department of the Interior
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Environmental Impact Statement

**VOLUME 1**

United States Department of the Interior
Prepared by Minerals Management Service

**February 1986**

READEX FICHE

# DRAFT ENVIRONMENTAL IMPACT STATEMENT
# PROPOSED 5-YEAR OUTER CONTINENTAL SHELF OIL AND GAS LEASING PROGRAM
## JANUARY 1987 TO DECEMBER 1991

Responsible Agency: U.S. Department of the Interior, Minerals
Management Service

Abstract: This environmental impact statement considers the adoption of a proposed 5-Year (January 1987 to December 1991) Outer Continental Shelf (OCS) oil and gas leasing schedule of 42 oil and gas lease sales in 21 planning areas on the OCS. The proposed schedule consists of 4 sales in the Atlantic Region, 12 sales in the Gulf of Mexico Region, 6 sales in the Pacific Region, 15 sales in the Alaska Region, and 5 small annual supplemental sales. The proposal also includes the deferral from leasing during this 5-year program of 14 subareas in the Atlantic, Gulf of Mexico, and Pacific Regions. An alternative to this proposal is examined which would defer from leasing during this 5-year program an additional 13 subareas within the various regions. A third alternative examines the effects of adding a single sale in the Straits of Florida planning area to the proposed schedule, bringing the total number of sales to 43 (the Atlantic coast portion of this planning area is proposed to be deferred from consideration for leasing in this 5-year program). A fourth alternative proposes to have a sale every two years in those areas which would have a sale every three years under the proposal. This would increase the number of sales to 48. A fifth alternative considers the effect of the implementation of an acceleration provision in all planning areas having a sale every three years. This would allow more rapid development of necessary resources in order to provide for changing geologic information or economic conditions but would not increase the number of sales expected in the program. A sixth alternative examines the deferral of leasing during the 5-year schedule of six planning areas. A no action alternative is also examined in which it is assumed that no new 5-year program would be approved.

Impacts on the environment could be caused by oil spills, discharges of drilling fluids, muds, cuttings, formation waters, and sanitary wastes, and emissions of pollutants from platforms, refineries and well blowouts. Additional impacts could be caused by physical alteration of the seafloor and land use competition and social and economic disruption in affected coastal areas.

The proposal could have low impacts on water quality while air quality could have very low to low impacts except in Southern California where levels could be moderate. Benthic communities are expected to have low impacts except in the South Atlantic where locally moderate levels could be reached, and in the Gulf of Mexico where very high levels could be reached if operations took place on very sensitive habitats. Very low to low impacts are expected to fish resources in most planning areas, except in the North Atlantic and Gulf of Mexico, where levels could be moderate. Marine mammals are expected to have low impacts except in Alaska where impacts could reach high levels in parts of some planning areas. Coastal and marine birds and endangered species may experience impacts from very

low to very high depending upon the location and timing of operations within different planning areas. Coastal habitats are expected to have very low to low impacts except in the Central Gulf of Mexico where moderate impacts may occur to wetlands.

Impacts to employment and demographic conditions and coastal land uses are expected to be very low to low throughout most of the OCS, possibly reaching high levels in Southern California. Commercial fisheries may experience very low to low impacts except in the Gulf of Mexico where moderate impacts might occur, and in the North Aleutian Planning Area where some high levels might occur. Socio-cultural and subsistence use patterns may experience impacts ranging from very low in southern Alaska to high in northern Alaska areas. Archaeological resource impacts are expected to be very low to low. Impacts to marine vessel traffic and ports are expected to be very low to low throughout most of the OCS with some moderate levels in Southern California, and up to high levels in northern Alaska. Very low to low impacts to military operating areas are expected except in Southern California where levels could reach moderate.

A detailed environmental analysis specific to each planning area will be prepared to consider the effects of each sale in the adopted schedule.

States Where the Proposed Action is Located: The proposed program includes sales offshore the following States: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, California, Oregon, Washington, and Alaska.

For further information regarding this statement, contact:

Daniel T. Henry
Minerals Management Service
Department of the Interior
18th & C Streets, N.W.
Washington, D.C. 20240
(202) 343-6264

Comments on this Draft EIS are due on May 8, 1986. Comments should be addressed to Deputy Associate Director for Offshore Leasing (Mail Stop 644) at the above address.

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# SUMMARY

## Proposed Action

The proposal, (Alternative I), consists of adopting a 1987-1991 schedule of 42 OCS oil and gas lease sales in 21 planning areas on the OCS. The proposed schedule lists 4 sales in the Atlantic Region (2 sales in the North Atlantic and 1 sale each in the Mid-and South Atlantic Planning Areas); 12 sales in the Gulf of Mexico Region (5 sales each in the Western and Central Gulf of Mexico Planning Areas and 2 sales in the Eastern Gulf of Mexico Planning Areas); 6 sales in the Pacific Region (2 sales each in the Southern California and Northern California Planning Areas and 1 sale each in the Central California and Washington-Oregon Planning Areas); and 15 sales in the Alaska Region (2 sales each in the Beaufort Sea, Chukchi Sea, Navarin Basin, and Shumagin Planning Areas, and 1 sale each in the Norton Basin, St. George Basin, North Aleutian Basin, Gulf of Alaska, Cook Inlet, Kodiak, and Hope Planning Areas).

Included in the total number of sales are 10 frontier exploration sales offshore the Atlantic, Washington-Oregon, and Alaska with the aim of increasing the schedule's flexibility in responding to changes in economic conditions and/or improved geophysical data. The schedule also includes five annual supplemental sales involving a limited number of selected blocks, i.e., drainage and development blocks and blocks on which bids were rejected in the preceding fiscal year. In addition, 14 subareas within 6 of the planning areas are proposed to be deferred from leasing in this 5-year program.

## Alternatives Considered Include:

(a) Alternative II - Subarea Deferrals

The Secretary identified 13 additional subareas for consideration for deferral from leasing in this 5-year program. This alternative provides a discussion of the potential impacts avoided if any or all of these subareas were deferred from leasing.

(b) Alternative III - Hold a Sale in the Straits of Florida

This alternative would add a sale in 1991 to the leasing schedule as outlined in Alternative I in that portion of the Straits of Florida Planning Area south of the Florida Keys. The Atlantic coast portion of this planning area is proposed to be deferred from consideration for leasing in this 5-year program.

(c) Alternative IV - Biennial Leasing

This alternative proposes a biennial rate of leasing in those planning areas which have triennial sales under Alternative I, the Proposal. This alternative adds a lease sale (in addition to the sales scheduled for Alternative I - the Proposal) in the following planning areas: Mid-and South Atlantic, Eastern Gulf of Mexico, Southern and Central

California, North Aleutian Basin, St. George Basin, Navarin Basin, Norton Sound, Chukchi Sea, and Beaufort Sea. The purpose of this alternative is to evaluate the potential effects of a faster rate of leasing than that presented in the proposal.

(d) Alternative V - The Acceleration Provision

This alternative evaluates the implementation of the acceleration provision in all planning areas which have a triennial leasing rate as described under Alternative I. The planning areas where such an accelerated leasing rate would be considered are: Eastern Gulf of Mexico; Southern, Central, and Northern California, North Aleutian Basin, St. George Basin, Navarin Basin, and Beaufort Sea. It is assumed that all triennial sales are accelerated to a biennial pace, but no new sales above the number proposed in Alternative I- the Proposed Action would be added to the schedule. The Secretary would not accelerate a sale unless he makes a finding that acceleration from triennial to biennial leasing is permissible on both environmental and multiple-use grounds.

(e) Alternative VI - Defer Leasing in Six Planning Areas

This alternative proposes the deferral from leasing during this 5-year program in the following six planning areas: North Atlantic, Southern, Central, and Northern California, Washington and Oregon, and North Aleutian Basin. The leasing schedule for the other planning areas is assumed to remain the same as in Alternative I.

(f) Alternative VII - No Action

Under this alternative it is assumed that the Secretary takes no action to implement a new 5-year leasing program, and, therefore, that no oil and gas leasing would occur for the foreseeable future.

## SUMMARY OF ENVIRONMENTAL IMPACTS:

Impacts on the physical, biological, and socioeconomic environments are generally caused by the following impact producing factors: (1) oil spills, acute and/or chronic; discharges of drilling fluids, muds, cuttings, formation waters, and sanitary and domestic wastes; and emissions of gases and pollutants from platforms and refineries, and from well blowouts with and without fires. (2) Physical alterations of the seafloor, disruption of the benthic environment and fishing gear conflicts due to platform and pipeline emplacement; service vessel traffic; and general offshore and onshore oil/gas related activities. (3) Land use competition between industry requirements and tourism, recreation, and transportation; changes in demographic and employment conditions; and disruption of sociocultural and subsistence patterns.

Alternative I, the Proposed Action, is expected to have only a low impact on water quality, both offshore and onshore, in any of the four OCS regions. Similarly, very low to low impacts are expected on air quality, with the Southern California Planning Area, where a moderate air quality impact level could be expected, being the exception. Intertidal and subtidal benthos, as well as plankton, are expected to sustain low or very low levels of regional impact, except for the South Atlantic where locally moderate, and the three Gulf of Mexico Planning Areas where locally very high levels of impacts on subtidal benthos could be expected. Impacts on fish resources generally are estimated to vary from very low to low in most planning areas. Only in the North Atlantic and in the three Gulf of Mexico Planning Areas impacts are expected to be moderate. Very high impact levels, however, could occur for red king crabs in the North Aleutian Basin Planning Area. With the exception of the Alaska OCS Region, where expected impact levels on marine mammals range from very low to high, only low impact levels are expected for these animals. Coastal and marine birds could sustain a moderate level of impacts in the Alaska OCS Region and in the Central and Western Gulf of Mexico Planning Areas. Expected levels of impact for the endangered right whale range from very low to very high in the Atlantic OCS Region. Other endangered/threatened species could sustain a moderate level of impact in the Gulf of Mexico OCS Region. In the Alaska OCS Region, impact levels for these animals could be expected to range from very low to very high, with sea otters and fur seals being especially at risk. Low to moderate levels of impact could be expected for estuaries, wetlands, and seagrass beds along the Gulf of Mexico coast. Elsewhere, only very low to low impacts are expected on these habitats. Areas of special concern, i.e., submarine canyons in the North Atlantic Planning Area, and coral reefs and hard bottom areas in the Gulf of Mexico could sustain moderate and very high levels of impact, respectively.

Employment and demographic conditions are expected to sustain only very low to low impact levels in the Atlantic, Gulf of Mexico, and Pacific OCS Regions. In the Alaska OCS Region, impact levels could range from very low to moderate. Coastal land uses and water services and supply could sustain a moderate impact level along the Atlantic and portions of the Alaskan coast. Moderate to high impact levels could be expected along the Southern California coast. Commercial fisheries could sustain moderate impact levels in the Gulf of Mexico. The rid king crab fishery in the North Aleutian Planning Area could expect high impact levels. Impact levles for recreation and tourism resources are expected to range from very low to low, except for portions of the Alaskan coast where impact levels could be moderate. Archaeological resources could sustain very low to low impact levels. Subsistence use patterns would sustain low to high impact levels in the northern portion of the Alaskan OCS Region and low to very low impact levels in the southern portion of the Alaskan as well as the Pacific OCS Region. Socio-cultural systems in the Alaskan OCS Region are expected to sustain impact levels ranging from very low to moderate. Marine vessel traffic, ports, and offshore infrastructure could experience moderate impact levels in the Southern California Planning Area and levels ranging from low to high in the northern portion of the Alaskan OCS Region. Eleswhere, impact levels of very low or low could be expected. Low conflicts with military uses of the OCS could be expected in the Gulf of Mexico OCS Region and low to moderate levels of impact on military uses in the Southern California Planning Area. In the remainder of the Pacific and in the Atlantic OCS Region, impact levels are expected to range from very low to low.

## Summary of Impacts of Alternative III

Adoption of Alternative III would not alter the expected level of impacts from those due to the proposal for all planning areas except the Straits of Florida Planning Area. Impacts of this alternative on the Straits of Florida Planning Area itself are summarized as follows: Water quality (offshore) and air quality are expected to sustain a low level of impact. Water quality (onshore) is expected to sustain impacts ranging from moderate to high. Marine vessel traffic and offshore infrastructure, military uses, archaeological resources and employment and demographic conditions (on a regional level) are expected to sustain very low levels of impact. Employment and demographic conditions (on a local level) would have impact levels that range from very low to low. A low level of impact would be expected for recreational resources and a moderate level of impact could be expected for coastal land uses and water services. The following resources could be expected to sustain a low level of impact: intertidal benthos, plankton, marine mammals, seabirds, endangered and threatened species, and estuaries and wetlands. Moderate levels of impact are expected for subtidal benthos and whales. A high level of impact is expected for fish resources. Areas of special concern and marine sanctuaries would have very high levels of impact.

## Summary of Impacts of Alternative IV

Impacts on all resources of the physical, biological, and socioeconomic environment in all four OCS Region are expected to remain the same as for those identified for Alternative I. Exceptions are that in the Navarin Basin Planning Area impacts on subsistence and sociocultural systems could increase from low to moderate. In the Norton Basin Planning Area impacts to salmon and pinniped resources could increase to moderate and to high on sociocultural systems.

## Summary of Impacts of Alternative V

Adoption of Alternative V would not alter the expected level of impacts from those due to the proposal for all planning areas. Under this alternative there would be the same number of sales and resultant OCS activity as under Alternative I but some sales would be held earlier. Impacts on all resources are expected to remain the same as for the proposal.

## Summary of Impacts of Alternative VI

Adoption of Alternative VI would defer leasing in six planning areas--North Atlantic, Washington and Oregon, Northern California, Central California, Southern California and North Aleutian. Thus, under this alternative for these six planning areas, impacts on all resources of the physical, biological, and socioeconomic environment would be avoided. The impacts on all other areas are expected to be the same as under the propoproposal.

## Summary of Impacts of Alternative VII

Selection of the No Action alternative would avoid impacts from oil and gas exploration, development, and production activities identified under Alternative I.

Oil and gas resources that would have been available would not contribute to the national energy reserves. The energy potential of the foregone oil and gas would have to be replaced by alternative energy sources or increases in import levels from foreign sources.

The table on the following page presents the schedule of sales for the Proposed 5-Year OCS Oil and Gas Leasing Program. This schedule differs from the schedule evaluated in Alternative I - the Proposed Action only in the following respect: the one proposed sale in the South Atlantic Planning Area, the two proposed sales in the Southern California Planning Area, and the two proposed sales in the Navarin Basin Planning Area are each scheduled one year later than indicated in the schedule of sales evaluated in Alternative I. These recent schedule changes, due to administrative considerations, and any further revisions to the schedule made after public review of the Proposed Program and this Draft EIS will be reflected in the Final EIS.

U.S. DEPARTMENT OF THE INTERIOR

# PROPOSED 5-YEAR OCS OIL AND GAS LEASING PROGRAM

FEBRUARY 1986

| SALE | SALE DATE | 1986 | | | | | | | | | | | | 1987 | | | | | | | | | | | | 1988 | | | | | | | | | | | | 1989 | | | | | | | | | | | | 1990 | | | | | | | | | | | | 1991 | | | | | | | | | | | |
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| | | J|F|M|A|M|J|J|A|S|O|N|D|J|F|M|A|M|J|J|A|S|O|N|D|J|F|M|A|M|J|J|A|S|O|N|D|J|F|M|A|M|J|J|A|S|O|N|D|J|F|M|A|M|J|J|A|S|O|N|D|J|F|M|A|M|J|J|A|S|O|N|D|
| 110 C. GULF OF MEXICO | 4/87 | | | | |E|H| | | | |F| |G| |N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 97 BEAUFORT SEA | 7/87 | | | | |E|H| | | | | | |F|P| |G| |N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 112 W. GULF OF MEXICO | 8/87 | | | | |E|H| | | | |F| | | | |P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SU1 SUPPLEMENTAL | 9/87 | | | | | | | | | | | | |C| |D|I|P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 109 CHUKCHI SEA | 10/87 | | | | | | | |E|H| | | | | | |F|P| |G| |N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 107 NAVARIN BASIN | 3/88 | | | | | | |E|H| | | | | | |F| | | | | | |P| |G| |N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 113 C. GULF OF MEXICO | 3/88 | | | | |C|D| |A| | | | | | | |E|H| | | | |F|P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 91 N. CALIFORNIA | 4/88 | |C| | |D| |A| | | | | | | |E|H| | | | | |F| |P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 86 SHUMAGIN | 4/88 | |A| | | | | | | | | |E|H| | | | | |F| | | |P| |G| |N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 85 S. CALIFORNIA | 5/88 | | | | |C|D| |A| | | | | | | |E|H| | | | | |F|P| |G| |N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *114 GULF OF ALASKA | 8/88 | | | | | | |C|D| |A| | | | | | | | | | |E|H| | | | |F|P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 115 W. GULF OF MEXICO | 8/88 | | | | |C|D| |A| | | | | | | |E|H| | | | |F| | | | | |P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SU2 SUPPLEMENTAL | 9/88 | | | | | | | | | | | | | | | | | | | | | | | | |C| |D|I|P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *96 N. ATLANTIC | 10/88 | | | | | |R| | | |C|D| |A| | | | | | | | |E|H| | | | |F| |P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 116 E. GULF OF MEXICO | 11/88 | | | | |C|D| |A| | | | | | | |E|H| | | | |F| | | | | | | | |P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 117 N. ALEUTIAN BASIN | 1/89 | | | | | | | | | | | |C|D| |A| | | | | | | | | | |E|H| | | | |F|P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 118 C. GULF OF MEXICO | 3/89 | | | | | | | | | | | | | | | | |C|D| |A| | | | | | | |E|H| | | | |F|P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 119 C. CALIFORNIA | 5/89 | | | | | | | | | | | | | | | | |C|D| |A| | | | | | | |E|H| | | | | |F| |P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 120 NORTON BASIN | 6/89 | | | | | | | | | | | | | | | | |C|D| |A| | | | | | | | | | |E|H| | | | |F|P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *121 MID-ATLANTIC | 7/89 | | | | | | | | | | | | | | |R| | | |C|D| |A| | | | | | | | |E|H| | | | |F| |P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 122 W. GULF OF MEXICO | 8/89 | | | | | | | | | | | | | | | | |C|D| |A| | | | | | | |E|H| | | | |F| | | | | |P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 101 ST. GEORGE BASIN | 9/89 | | | | | | | | | | | | | | | | | | | |C|D| |A| | | | | | | | | | |E|H| | | | |F|P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SU3 SUPPLEMENTAL | 9/89 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |C| |D|I|P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *106 S. ATLANTIC | 2/90 | | | | | | | | | | | | | | | | | | | | | |R| | | |C|D| |A| | | | | | | | |E|H| | | | |F| |P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | | |
| 123 C. GULF OF MEXICO | 3/90 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |C|D| |A| | | | | | | |E|H| | | | |F|P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | | |
| 124 BEAUFORT SEA | 5/90 | | | | | | | | | | | | | | | | | | | | | | | | | | | |C|D| |A| | | | | | | | | | |E|H| | | | |F|P| |G|N|S| | | | | | | | | | | | | | | | | | | | | |
| 125 W. GULF OF MEXICO | 8/90 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |C|D| |A| | | | | | | |E|H| | | | |F| | | | | |P| |G|N|S| | | | | | | | | | | | | | | | | | | | |
| SU4 SUPPLEMENTAL | 9/90 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |C| |D|I|P| |G|N|S| | | | | | | | | | | | | | | | | | | | | | |
| 126 CHUKCHI SEA | 11/90 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |C|D| |A| | | | | | | | | | |E|H| | | | |F|P| |G|N|S| | | | | | | | | | | | | | | | | | |
| *127 KODIAK | 1/91 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |R| | | |C|D| |A| | | | | | | | | | |E|H| | | | |F|P| |G|N|S| | | | | | | | | | | | | | | | |
| 128 N. CALIFORNIA | 2/91 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |C|D| |A| | | | | | | |E|H| | | | | |F| |P| |G|N|S| | | | | | | | | | | | | | |
| *129 SHUMAGIN | 2/91 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |R| | | |C|D| |A| | | | | | | | | | |E|H| | | | |F|P| |G|N|S| | | | | | | | | | | | | | |
| 130 NAVARIN BASIN | 3/91 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |C|D| |A| | | | | | | | | | |E|H| | | | |F|P| |G|N|S| | | | | | | | | | | | | |
| 131 C. GULF OF MEXICO | 3/91 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |C|D| |A| | | | | | | |E|H| | | | |F|P| |G|N|S| | | | | | | | | | | | | |
| *132 WASHINGTON-OREGON | 4/91 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |R| | | |C|D| |A| | | | | | | |E|H| | | | | |F| |P| |G|N|S| | | | | | | | | | | | |
| *133 HOPE BASIN | 5/91 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |R| | | |C|D| |A| | | | | | | | | | |E|H| | | | |F|P| |G|N|S| | | | | | | | | | | |
| *134 N. ATLANTIC | 6/91 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |R| | | |C|D| |A| | | | | | | | |E|H| | | | |F| |P| |G|N|S| | | | | | | | | | |
| 135 W. GULF OF MEXICO | 8/91 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |C|D| |A| | | | | | | |E|H| | | | |F| | | | | |P| |G|N|S| | | | | | | | |
| *136 COOK INLET | 9/91 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |R| | | |C|D| |A| | | | | | | | | | |E|H| | | | |F|P| |G|N|S| | | | | | | |
| SU5 SUPPLEMENTAL | 9/91 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |C| |D|I|P| |G|N|S| | | |
| 137 E. GULF OF MEXICO | 11/91 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |C|D| |A| | | | | | | |E|H| | | | |F| | | | | | | | |P| |G|N|S| |
| 138 S. CALIFORNIA | 12/91 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |C|D| |A| | | | | | | |E|H| | | | | |F| |P| |G|N|S|

* Frontier Exploration Sale. The question of whether the Call for Information and Nominations for these sales will be issued will be addressed in light of responses to the Request for Interest.

R – Request for Interest  C – Call for Information & Nominations  D – Comments on Call Due  A – Area Identification  E – Draft EIS  H – Public Hearing  F – Final EIS

I – Issue Environmental Assessment for Supplemental Sale  P – Proposed Notice of Sale  G – Governor's Comments Due  N – Notice of Sale  S – Sale

# I. PURPOSE AND NEED FOR THE ACTION

## A. Purpose

The Department of the Interior (DOI) is currently preparing a new 5-Year Outer Continental Shelf (OCS) Oil and Gas Leasing Program for 1987 through 1991. The proposed leasing program consists of a schedule of 37 oil and gas lease sales and 5 annual supplemental sales to be held in 21 of the 26 planning areas established on the OCS (see Chapter II).

The Proposed Program will contain a schedule of proposed lease sales "indicating, as precisely as possible, the size, timing, and location of leasing activity" and program policies selected by the Secretary, while at the same time reflecting the provisional nature of the Proposed Program stage of the development of the new program. The sales resulting from the program are designed, among other purposes, to "result in expedited exploration and development of the OCS in order to achieve national economic and energy policy goals, assure national security, reduce dependence on foreign sources, and maintain a favorable balance of payments in world trade..." (OCS Lands Act (OCSLA) Amendments of 1978). The requirement to issue such a program was established through the 1978 amendments to the OCS Lands Act by the addition of a new provision--section 18.

Section 18 mandates that DOI issue a program which identifies the size, timing, and location of leasing and provides for the receipt of fair market value for lands leased and rights conveyed. Section 18 spells out in detail both the factors to be considered in the formulation of the new leasing program and the public consultation process which is designed to provide further information to be considered. The requirements of section 18 have been interpreted by the October 6, 1981, and July 5, 1983, decisions of the U.S. Court of Appeals for the District of Columbia Circuit. The July 5, 1983, decision upheld the 1982 leasing program currently in effect.

Three successive versions of the new program are developed and submitted for review. The Draft Proposed Program was submitted to the Governors of coastal States and the public in March 1985. The Proposed Program will be submitted for review to those same parties and to the Attorney General and Congress. This environmental impact statement (EIS) is being prepared on the Proposed Program. Following the public comment and review process under section 18, a Proposed Final Program will be prepared and submitted to the President and Congress.

## B. Need For the Action

Section 18 of the OCSLA directs the Secretary of the Interior to develop and maintain a 5-year program of OCS lease sales to meet the purposes of the Act, as amended. One of the principal purposes of the Act is to establish policies and procedures which will result in expedited exploration and development of the oil and gas resources of the OCS in order to achieve national economic and energy policy goals. In 1984, the United

States imported about 30 percent of the crude oil which it consumed. Disruptions in oil imports which the United States has suffered make clear the relation of foreign and national security policy and economic policy with respect to the oil import issue. The disruptions of 1973 and 1979 both arose in the international arena, and both had substantial recessionary effects on the U.S. economy. The most recent National Energy Policy Plan, issued by the Department of Energy in October 1983, recognizes this connection. The National Energy Policy Plan sets forth as the general goal of national energy policy the fostering of an adequate supply of energy at a reasonable cost. Adequate supply is explained in the Plan as requiring a "flexible energy system that avoids undue dependence on any single source of supply, foreign or domestic, and thereby contributes to national security . . . (and) further implies freedom of choice about the mix and measure of energy needs to meet our industrial, commercial, and personal requirements." The National Energy Policy Plan recognizes OCS leasing as an important element in the Nation's effort to pursue the assurance of long-term energy supplies.

OCS oil and gas produced at a cost lower than prices set by the world oil market contributes to the Nation's economic productivity. The greater the amount of OCS oil and gas produced at costs less than world oil prices, the greater is that contribution. Economic productivity is increased by allowing firms a range and sequence of opportunities that will allow an economically efficient path of investments in OCS exploration and production. In general, this will increase the amount of oil and gas discovered and produced, thus benefitting the economy.

A substantial percentage of our oil supply is imported. In the 1970 to 1980 time period, domestic oil and gas production represented approximately 50 to 60 percent of the total energy supplied to the U.S. economy, of which imports of oil and gas supplied approximately 11 to 18.5 percent. The U.S. Department of Energy projections to the year 2000 indicate that imported oil and gas will continue to supply an estimated 14.6 percent of our total domestic energy in the year 2000. Imported gas constitutes only 3 percent of the 14.6 percent. Although this percentage has decreased from a high of 18.5 percent in 1975, in 1980, in absolute terms, imports are projected to increase to 13.4 quad Btu in 1990 (a level which they were at in 1975) and are projected subsequently to rise to 13.6 quad Btu in the year 2000. Domestic production of oil and gas is projected to decrease from 19.5 quad Btu to 17.4 quad Btu in the 1985-2000 time period.

Leasing and exploration of OCS oil and gas resources provide an important way of helping to slow the long-term decline of proved domestic hydrocarbon reserves. The hydrocarbons produced from the OCS in Fiscal Year 1984 represented about 12 percent of domestic production of oil and about 25 percent of domestic natural gas production. In addition to benefitting from the use of domestic oil and gas to fuel the general level of economic activity, the American people benefit in their roles as owners, through the Federal Government, of the resources of OCS. As owners of OCS oil and gas, the American people benefit from production of any OCS resource costing less to find and produce than the price at which it can be sold.

Aside from the effects of a potential supply disruption, the importation of foreign oil reduces the economic well-being of the American people. In 1984, the gross cost of importing crude oil and refined petroleum products amounted to over $59 billion. Those imports accounted for almost 50 percent of our balance of trade deficit in that year. The recent growth in U.S. Gross National Product (GNP) of about 6.8 percent for 1984 resulted in U.S. oil demand exceeding that of 1983 by about 3.5 percent. The lag in demand for oil is caused in a large part by substitution and conservation effects which have yet to run their course.

Disruption of supplies of oil from abroad causes disruption in the production and consumption of goods and reduces economic productivity. This causes decreases in income and increases in consumer price levels. The 1984 Office of Technology Assessment (OTA) Report, U.S. Vulnerability to an Oil Import Curtailment, estimates that a significant disruption of oil imports could result in a reduction of the GNP of 3.5 to 6.2 percent, accompanied by increased unemployment of 1.7 to 2.3 percent.

Measures to assure that our national energy needs will be met have economic costs. The economy needs to adjust continually, balancing the costs of those measures against their economic benefits. The OCS leasing program can help to meet both national energy and economic needs by helping to reduce oil imports and providing a source of domestic supply in periods of future disruptions and higher prices.

It is possible that world oil prices in the 1990's will be sufficiently low to render uneconomic many of the oil and gas prospects remaining to be leased on the OCS. On the other hand, oil prices may not decline or remain low for very long. Higher oil prices would increase the number of good prospects for discovery of oil and gas on the OCS. The rate of leasing and investment in exploration would be higher. The resulting production would help the economy use less, high cost, imported oil, thus increasing its economic productivity.

Over the long run, OCS oil and gas resources will make a contribution to economic productivity if investment and production decisions can adjust quickly to changing world energy markets. An OCS leasing program can help meet the Nation's energy and economic needs by providing opportunities for investments in exploration and development when they are economically timely. Such a program would allow increases in leasing and investment if world oil prices were to increase to higher plateaus, while allowing a lower investment and production rate during periods of lower prices. Allowing a shift from imported to domestic oil when prices increase reduces the economic costs of abrupt changes in the world oil supply.

The continuing dependence of the United States on oil imports for a substantial part of our oil consumption creates a number of national security concerns. The potential for a supply disruption imposes political limits on the flexibility of our foreign and national security policy, including our ability to respond to foreign security threats. Our dependence on foreign nations for so essential a commodity as oil creates the potential for the United States to be drawn into dangerous political and military situations involving those nations. Dependence on oil imports entails dependence on extended supply lines (tanker routes) which present a target for attack and, thus, add to our defense burden.

Information benefits are another type of benefit from OCS leasing, exploration, and development. Information benefits are the benefits to the Nation, beyond economic benefits, of added information about the extent of oil and gas resources on the OCS. The generation of information benefits is one of the specified purposes of the 1978 OCSLA Amendments. Section 102(9) of the Amendments states that one of the purposes of the Act is to "insure that the extent of oil and natural gas resources of the Outer Continental Shelf is assessed at the earliest practicable time." It is of the nature of oil and gas resource assessment that only drilling can confirm the existence and size of a deposit. On the OCS, drilling for oil and gas is essentially tied to leasing and, thus, to the 5-Year leasing program.

In addition to meeting national energy needs, the 5-Year Program must, under section 18(a)(2) of the OCSLA, as amended, be prepared and maintained in a manner consistent with the principle that the timing and location of exploration, development, and production of oil and gas bearing physiographic regions of the OCS be based on consideration of:

(1) Existing information concerning the geographical, geological, and ecological characteristics of such regions;

(2) An equitable sharing of developmental benefits and environmental risks among the various regions;

(3) The location of regions with respect to, and the relative needs of, regional and national energy markets;

(4) The location of regions with respect to other uses of the sea and seabed, including fisheries, navigation, existing or proposed sealanes, potential sites of deepwater ports, and other anticipated uses of the resources and space of the OCS;

(5) The interest of potential oil and gas producers in the development of oil and gas resources as indicated by exploration or nomination;

(6) Laws, goals, and policies of affected States which have been specifically identified by the Governors of such States as relevant matters for the Secretary's consideration;

(7) The relative environmental sensitivity and marine productivity of different areas of the OCS, and

(8) Relevant environmental and predictive information for different areas of the OCS.

Finally, section 18(a) requires the Secretary, on the basis of the above information and to the maximum extent practicable, to select the timing and location of leasing so as to obtain a proper balance among the potential for environmental damage, the potential for the discovery of oil and gas, and the potential for adverse impacts on the coastal zone. Those section 18 factors bearing on environmental impacts are analyzed and discussed in this statement. However, this document is only one tool used by the Secretary in carrying out his responsibility to strike the proper balance, to the maximum extent practicable, between the potential for environmental risk, the potential for discovery of hydrocarbon, and the potential for adverse impacts on the coastal zone as required by section 18(a)(3).

## C. Administrative Events Leading to the Proposal

The initiation of development of the new lease sale schedule was announced in letters to the Governors of coastal States and to interested Federal Agencies, dated July 5, 1984, and in a Federal Register Notice published on July 11, 1984 (49 FR 28332). Responses were requested on several specific topics:

(1) Information and methodologies relating to the eight specific factors requiring consideration under Section 18(a)(2);

(2) Suggestions for any possible planning area boundary revisions;

(3) Suggestions for possible changes in the leasing process to allow it to adjust as new information becomes available;

(4) From industry only, rankings of planning areas by resource potential and interest as well as information on technological feasibility of operations and appropriate timing of leasing in each planning area.

The July 1984 Notice also requested information regarding environmental concerns and risks, other uses of the OCS, information pertaining to the location of OCS Regions with respect to energy markets, and information on the laws, goals, and policies of affected States.

More than 150 comments were received. Many Governors were concerned about possible impacts to their States as a result of OCS development, especially impacts on tourism and recreation, community infrastructure, the commercial fishing industry, air quality, pristine coastlines, wetlands, sensitive offshore biological resources, endangered species, and other uses of the OCS including defense and navigation. Many Governors requested that specific areas be deleted from the leasing program to protect some of the resources of concern, and some made requests on the timing of OCS sales in nearby Federal waters. Several industry commenters stated that equitable sharing requires more opportunities to explore promising areas outside the Gulf of Mexico.

The Secretary's selection of a Draft Proposed Program was announced in letters to the Governors of coastal States and to interested Federal Agencies dated March 19, 1985, and in a Federal Register Notice published on March 22, 1985 (50 FR 11585). The new Proposed 5-Year Program includes

37 lease sales in 21 OCS planning areas covering the period 1987 through 1991 and 5 annual supplemental sales. It schedules proposed lease sales "indicating, as precisely as possible, the size, timing, and location of leasing activity" and program policies selected by the Secretary. The Proposed Program will provide guidance for presale steps for sales to be held beyond the current schedule. Sales will continue to be held in accordance with the current schedule until the new program receives final approval.

Under section 18(c)(2) of the OCSLA and 30 CFR 256, the Proposed Program, and the analysis on which it is based, will be submitted for review to the Governors and local governments of coastal States and to other parties, and a Notice on the Proposed Program will be published in the Federal Register. Comments of the Governors and localities and of others on the Proposed Program and the draft EIS will be considered in the preparation of the Proposed Final Program.

## D. Regulatory Framework

### 1. Department of the Interior Responsibilities

The following is a discussion of the laws and regulations which prescribe DOI's responsibilities in administering the OCS Oil and Gas Leasing Program.

#### a. Outer Continental Shelf Lands Act

The OCSLA of 1953 (67 Stat. 462), as amended in 1978 (P.L. 95-372; 92 Stat. 629), established Federal jurisdiction over submerged lands on the OCS seaward of State boundaries (generally 3 geographic miles seaward of the coastline). Under the OCSLA, the Secretary of the Interior is responsible for the administration of mineral exploration and development of the OCS. The Act empowers the Secretary to grant leases to the highest qualified responsible bidder(s) on the basis of sealed competitive bids and to formulate such regulations as necessary to carry out the provisions of the Act.

The Act, as amended, provides guidelines for implementing an OCS oil and gas exploration and development program. The basic goal of the Act is to expedite exploration and development of OCS minerals in order to achieve national economic and energy policy goals, assure national security, reduce dependence on foreign sources of oil, and maintain a favorable balance of payments in world trade. With respect to implementing a leasing program, this goal is constrained by the following considerations: (1) the receipt of fair and equitable return on oil and gas resources; (2) preservation and maintenance of competition; and (3) balancing orderly energy resource development with protection of the human, marine, and coastal environments.

The Secretary of the Interior has designated the Minerals Management Service (MMS) as the administrative Agency responsible for the leasing of submerged OCS lands, and for the supervision of offshore operations after lease issuance. Regulations administered by the MMS govern the leasing of mineral deposits on the OCS and the granting of rights-of-way for pipelines, and the conduct of mineral operations are contained in 30 CFR Part 250, and are supplemented by OCS Operating Orders on an area-specific basis.

### (1) Information and Coordination

The OCSLA, as amended, provides a statutory foundation for the Department's policy of coordinating OCS activities with affected States and, to a more limited extent, local governments.

Section 18 of the OCSLA requires a detailed review process in developing the leasing program schedule. This review involves significant participation of affected States, Federal Agencies, and the public, as well as submission of the program's schedule to the President and Congress before the Final 5-year OCS Oil and Gas Leasing Program can be approved by the Secretary of the Interior.

Section 19 of the OCSLA sets forth the framework for coordination and consultation with affected States and local governments for each proposed lease sale. Governors of each affected State are invited to submit recommendations regarding the size, timing, or location of a proposed sale or with respect to a proposed development and production plan. The Secretary must accept these recommendations if he finds that they reasonably balance the national interest in obtaining oil and gas supplies in a balanced manner with the interests of citizens of the affected State.

Under section 26 of the OCSLA, as amended, the Secretary must make available to affected States a summary of data to aid them in planning for the onshore impacts of OCS oil and gas activities. The summary includes estimates of oil and gas reserves in areas leased or to be leased; estimated size and timing of development if and when oil and/or gas is found; pipeline locations, if any; and the general location and nature of anticipated onshore facilites.

In addition, section 26 requires transmittal to each affected State of an index of all relevant actual or proposed programs, plans, reports, EIS's, and other lease sale information.

Further coordination in the OCS Leasing Program is implemented through the Regional Technical Working Groups, which include State representatives, who participate in MMS's Intergovernmental Planning Program for OCS Oil and Gas Leasing, Transportation and Related Facilities. The Technical Working Groups carry out a program that was established to provide a formal mechanism for regional coordination and planning of three elements of the OCS program administered by the MMS: (1) the leasing process, (2) the Environmental Studies Program, and (3) OCS oil and gas transportation planning.

### (2) Offshore Oil Pollution Compensation Fund

Title III of the OCSLA Amendments (92 Stat. 629) established in the U.S Treasury an Offshore Oil Pollution Compensation Fund to indemnify claims for economic loss arising out of or directly resulting from oil pollution. Fees, levied on oil obtained from the OCS, are designed to ensure that the Fund is maintained at a level not less than $100 million or more than $200 million.

Claims may generally be asserted by any claimant for: removal costs; damages, including injury to or destruction of real or personal property; loss of use of real or personal property; injury to, destruction of, or loss of use of natural resources; loss of profits or impairment of earning capacity; and/or loss of tax revenue.

Owners/operators of nonpublic vessels transporting OCS oil and owners/operators of offshore facilities are held strictly liable for claims attributable to oil pollution from their vessels or facilities. Except in cases of gross negligence, willful misconduct, or violation of Federal regultions, liability is limited in the case of vessels to the greater of $250,000 or $300 per gross ton; and in the case of an offshore facility, liability is limited to the total of cleanup and removal costs, and $35 million in damages.

### (3) Fishermen's Contingency Fund

Title IV of the OCSLA Amendments established this fund in the U.S. Treasury to compensate commercial fishermen for property or economic loss due to activities associated with oil and gas exploration, development, or production on the OCS. Damage or loss that occurs in non-OCS waters may be eligible for compensation if the item(s) causing the damage or loss was (were) associated with OCS oil and gas activities.

The fund is available without fiscal year limitation as a revolving fund to carry out the purposes of the OCSLA. Each holder of an exploration permit, lease, easement, or right-of-way for the construction of a pipeline, or a prelease exploration drilling permit in effect on or after June 30, 1982, shall pay assessments to the fund. No holder, however, shall be required to pay in excess of $5,000 for any lease, permit, easement, or right-of-way in any calendar year.

Damages or losses are presumed to be caused by items associated with OCS oil and gas activities, provided the claimant established that: (1) the commercial fishing vessel was being used for commercial fishing and was located in an area affected by OCS oil and gas activities; (2) the 5-day report was filed; (3) no record of an obstruction in the immediate vicinity is in the most recent National Oceanic and Atmospheric Administration (NOAA)/NOS nautical charts or weekly Notice to Mariners; and, (4) no proper surface marker or lighted bouy marked the obstruction.

### (4) Best Available and Safest Technology

According to section 21(b) of the OCSLA, all new drilling and production operations and existing operation, wherever practicable, must use the best available and safest technology (BAST) which the Secretary determines to be economically feasible. This requirement can only be waived when incremental benefits are clearly insufficient to justify increased costs. Likewise, it is the responsibility of an operator on an existing operation to demonstrate why application of a new technology would not be practicable. This requirement is applicable to equipment which, if it failed, would have a significant effect on safety, health, or the environment, unless benefits clearly do not justify the costs.

### (5) Air Quality

Section 5(a)(8) of the OCSLA provides that the Secretary shall promulgate and administer regulations to provide for compliance with the National Ambient Air Quality Standards (NAAQS) pursuant to the Clean Air Act (CAA) to the extent that OCS activities significantly affect the air quality of any State. This has been accomplished through 30 CFR 250.57 (45 FR 15128, March 7, 1980) and administered by MMS as a postsale activity. Those regulations in 30 CFR 250.57 protect onshore air quality and insure that OCS activities do not prevent attainment status, thus providing for compliance with the NAAQS pursuant to the CAA.

## b. Other Laws

This section includes a brief summary of Federal laws which directly or indirectly relate to the OCS mineral leasing program responsibilities of the DOI. The discussion relates only to those portions of the law affecting OCS activities, and includes responsibilities and jurisdictions of Agencies and Departments other than Interior.

### (1) National Environmental Policy Act of 1969

The National Environmental Policy Act (NEPA) of 1969 (42 USC 4321 et seq.) requires that all Federal Agencies shall utilize a sytematic, interdisciplinary approach to protection of the human environment, which will ensure the integrated use of the natural and social sciences in any planning and decisionmaking which may have an impact upon the environment. The NEPA requires the preparation of a detailed EIS on any major Federal action that may have a significant impact on the environment, any adverse environmental effects which cannot be avoided or mitigated, alternatives to the proposed action, the relationship between short-term uses and long-term productivity of the environment, and any irreversible and irretrievable commitments of resources involved in the project.

1979, the Council on Environmental Quality published regulations which established uniform regulations for implementing the procedural provisions of the NEPA. These regulations (40 CFR 1500-1508, revised July 1, 1980), are aimed at accomplishing three principal goals: (1) to reduce paperwork and improve the quality of EIS's, to reduce delays, and to make the impact statement more useful to decisionmakers and the public; (2) to produce better decisions which further the national policy to protect and enhance the quality of the human environment; and (3) to emphasize the need to focus on real environmental issues and alternatives. A procedure, known as "scoping," was established to identify the scope and signficance of important environmental issues associated with a proposed Federal action through coordination with Federal, State, and local agencies, the public, and any interested individual or organization prior to the development of an impact statement. The process is also intended to identify and eliminate from further detailed study issues which are not significant or which have been covered by prior environmental review.

### (2) Endangered Species Act of 1973

The Endangered Species Act of 1973 (16 U.S.C 1531-1543), as amended, establishes a national policy designed to protect and conserve threatened and endangered species and the ecosystem upon which they depend. This Act is administered by the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS). Section 7 of the act, governing interagency cooperation, requires Federal Agencies to formally consult with NMFS and FWS when there is reason to believe that a species which is on the list as endangered or threatened (or is proposed to be listed as such) may be affected by a proposed action. Agencies must ensure that proposed actions are not likely to jeopardize the continued existence of a threatened or endangered species, and/or to result in adverse modification or destruction of their critical habitat.

Under section 7, formal endangered species consultation with both NMFS and FWS as appropriate, is required to provide a threshold examination and biological opinion on the likelihood that the proposed activity will or will not jeopardize the continued existence of the resource, and on the effects of such exploration activities on the endangered species. The biological opinion may include recommendations for modification of the proposed activity. If insufficient information is available, as a result of the threshold examination, to conclude that the proposed activity is not likely to jeopardize the species or its habitat, the Federal Agency is notified in writing. The affected Agency is then required to obtain additional information, and if recommended by NMFS or FWS, will conduct appropriate biological surveys or studies to determine how the proposed activity may affect the endangered species or its critical habitat. After such additional information is received, NMFS or FWS would conclude the consultation process by issuance of a formal biological opinion.

### (3) Marine Mammal Protection Act of 1972

The Marine Mammal Protection Act (MMPA) of 1972 (16 U.S.C. 1361 et seq.), as amended, establishes a national policy designed to protect and conserve marine mammals and their habitats. This policy is established so as not to diminish such species or population stocks beyond the point at which they cease to be a significant functioning element in the ecosystem, nor to diminish such species below their optimum sustainable population. The Marine Mammal Commission is responsible for reviewing and advising Federal Agencies on the protection and conservation of marine mammals. The Commission has a Committee of Scientific Advisors which provides advice on actions needed to fulfill the purposes of the Act.

The Act authorizes the Commission to make recommendations on the prohibition of the taking and importation of marine mammals and marine mammal products, except as expressly provided for by an international treaty, convention, or agreement to which the United States is a party. The Act provides certain exemptions to the taking of marine mammals by Alaska Natives under certain conditions. Authority for administering the Act has been delegated to both the Department of Commerce NMFS which is responsible for all cetaceans and pinnipeds (except walrus), and to the DOI FWS, which is responsible for walrus, sea otters, manatees, and dugongs.

### (4) Fish and Wildlife Coordination Act (FWS)

The Fish and Wildlife Coordination Act (16 U.S.C. 661-666c), as amended, was established in 1934 to promote the national policy of conservation of wildlife, fish, and game resources. The Act provides that wildlife conservation shall receive equal consideration and be coordinated with other features of water-resource development programs through the effectual and harmonious planning of development. The Act authorizes the DOI FWS to administer its provisions. It requires interagency consultation with FWS on any projects which would impound, divert, channel, or deepen a channel, stream, or other body of water for whatever purpose, including navigation and drainage.

### (5) National Historic Preservation Act

The National Historic Preservation Act (80 Stat. 915, 16 U.S.C. 470), as amended, established a program for the preservation of additional historic properties throughout the United States, and established the Advisory Council on Historic Preservation as an independent Agency to advise the President and Congress on historic preservation matters, recommend measures to coordinate Federal historic preservation activities, and comment on Federal actions affecting properties included in, or eligible for, inclusion in the National Register of Historic Places.

Properties are listed in the National Register or declared eligible for listing by the Secretary of the Interior. Section 106 provides for a public interest process in which a Federal Agency proposing an undertaking, the State Historic Preservation Officer, the Advisory Council on Historic Preservation, and interested organizations and individuals participate. This process is designed to assure that alternatives to avoid or mitigate an adverse effect on a National Register or eligible property are adequately considered in the planning process.

Section 1(3) of Executive Order 11593 (May 13, 1971 36 FR 8921), "Protection and Enhancement of the Cultural Environment," requires that Federal Agencies in consultation with the Council institute procedures to assure that their plans and programs contribute to the preservation and enhancement of nonfederally owned historic and cultural properties.

### (6) Federal Water Pollution Control Act

The Federal Water Pollution Control Act (FWPCA) (33 U.S.C. 1251-1367), as amended, established a policy to provide for water pollution control activities to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. These activities are administered by the U.S. Environmental Protection Agency (EPA).

The Clean Water Act of 1977 (91 Stat. 1566 (1977)) amended the Federal Water Pollution Control Act. Title III of the Act requires EPA to establish national effluent limitation standards for existing point source of waste-water discharges which reflect the application of "best practical control technology currently available." These standards apply to existing OCS exploratory drillships, semisubmersible vessel, and jackup rigs used in exploration activities. The Act also requires EPA to establish regulations for effluent limitations for categories and classes of point sources which require the application of "best available control technology economically achievable."

Section 311 of the Act, as amended, prohibits the discharge of oil or hazardous substances into the navigable waters of the United States which may affect natural resources, except under limited circumstances; and establishes civil penalty liability and enforcement procedures to be administered by the U.S. Coast Guard.

Title IV establishes requirements for Federal permits and licenses to conduct an activity (including construction or operation of facilities) which may result in any discharges into navigable waters. Section 402 of the Act confers authority upon EPA to issue permits for discharge of pollutants of the National Pollution Discharge Elimination System (NPDES) permits issued by EPA. The NPDES permits apply to all sources of wastewater discharges from exploratory vessels and production platforms operating on the OCS.

### (7) Deepwater Port Act of 1974

The Deepwater Port Act of 1974 (88 Stat. 2126), as amended, was enacted to regulate commerce, promote efficiency in transportation, construction, and operation of deepwater ports in waters beyond the territorial waters of the United States.

The Secretary of Transportation is delegated the authority for the licensing of deepwater ports. Deepwater ports are defined as "any fixed or floating manmade structures other than a vessel, or any group of such structures, located beyond the territorial sea and off the coast of the United States, and which are used or intended for use as a port or terminal for the loading or unloading and further handling of oil for transportation to any state."

The Coast Guard, under this Act, has the authority to ensure the safety of the offshore facility and vessels that may be traveling near it.

### (8) Clean Air Act

The CAA (69 Stat. 322 (1955) (42 U.S.C. 7401-7642)), as amended, authorizes the EPA to provide for air pollution prevention and control: specifically, (a) to protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population; (b) to initiate and accelerate a national research and development program to achieve the presentation and control of air pollution; (c) to provide technical and financial assistance to State and local governments in connection with development and execution of their air pollution prevention and control programs; and (d) to encourage and assist the development and operation of regional air pollution control programs.

The Act authorizes EPA to establish national/primary ambient air quality standards and regulations for implementation of enforcement of these primary standards within air quality control regions of each State, as well as NAAQS for hazardous air pollutants.

The Act requires that the Federal Departments or Agencies having jurisdiction over any property or facility or engaged in any activity resulting in the discharge of air pollutants comply with all Federal, State, interstate, and local requirements in the control and abatement of air pollution.

### (9) Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) of 1972, as amended (16 U.S.C. 1451-1464), is administered by NOAA. It establishes a procedure for each coastal State to develop a management program for the sound management of State coastal resources. The Act provides Federal grants for both development and implementation of these programs; in order to be implemented, each program must be approved by the Secretary of Commerce. It also creates a grant and loans program for participating States that must deal with the coastal zone impacts of OCS oil and gas and other energy development.

Section 307 of the CZMA contains the Federal consistency provisions which impose certain requirements on Federal Agencies to comply with approved State coastal zone management programs.

Section 307(c)(1) requires Federal Agencies conducting or supporting activities directly affecting the coastal zone to be consistent to the maximum extent practicable with the State's coastal program. The Supreme Court ruled in 1984 that this provision does not apply to DOI's OCS preleasing or leasing activities.

Section 307(c)(3)(A) prohibits Federal Agencies from issuing a license or permit for any activity that affects land use or water use in the State's coastal zone until a State with an approved coastal zone management program has agreed, or is presumed to agree, that the activity subject to the license or permit, is consistent with the approved program, or until the Secretary of Commerce has overridden the State's objections to the activity.

Section 307(c)(3)(B) of the CZMA consistency provisions is very important to OCS resource development. This provision requires that no Federal license or permit for an activity described in detail in an OCS Exploration Plan or Development and Production Plan which affects land use or water use in the coastal zone may be approved until a State with an approved coastal zone management plan has concurred in the consistency determination made by the lessee, is presumed to concur, or until the Secretary of Commerce has overridden the State's objections.

### (10) Port and Waterways Safety Act

The Port and Waterways Safety Act (86 Stat. 424 (1970) (33 U.S.C. 1221-1232), as amended, was enacted to promote the safety of ports, harbors, waterfront areas, and navigable waters of the United States. The Act was amended by the Port and Tanker Safety Act (92 Stat. 1471 (1978)). As amended, the Act provides for "protection of navigation and vessel safety and protection of the marine environment." The Secretary of the Department in which the Coast Guard is operating is authorized to carry out the purposes of the Act.

The Act authorizes increased supervision of vessel and port operations to reduce vessel or cargo loss; or damage to life, property, or the marine environment and prevent damage to stuctures in, on, or immediately adjacent to the navigable waters of the United States or the resources within such waters. It also requires that the Secretary insure that vessels operating in U.S. navigable waters comply with all applicable standards and requirements for vessel constuction, equipment, manning and operational procedures, and that the handling of dangerous articles and substances within navigable waters be conducted within established standards and requirements.

### (11) Marine Protection, Research, and Sanctuaries Act of 1972

The Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972 (86 Stat. 1052) (33 U.S.C. ) was enacted to regulate transportation and the dumping of material into ocean waters and to prevent or strictly limit the dumping into ocean waters of any material which would adversely affect human health or welfare, the marine environment, ecological systems, or economic potentialities.

Title I of the Act is administered by the EPA. Section 102 of the Act provides that the EPA may issue permits, after public notices and hearings, for transportation of material for the purpose of dumping into ocean waters, after a determination that such dumping will not unreasonably degrade or endanger human health, welfare, or the marine environment.

Title III of the Act relates to the designation of marine sanctuaries. The Department of Commerce is authorized to designate as marine sanctuaries those areas which are determined necessary for the purpose of preserving or restoring such areas for their conservation, recreational, ecological, or esthetic value. The Act requires consultation with affected State(s) prior to any such designation of a marine sanctuary.

### (12) Alaska National Interest Lands Conservation Act

Section 810 of the Alaska National Interest Lands Conservation Act (ANLICA), (16 U.S.C. 3120) creates special steps a Federal Agency must take before it decides to "withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public land." Specifically, the Agency must first evaluate three factors: the effect of its action on subsistence uses and needs, the availability of other lands for the purposes sought to be achieved, and alternatives which would "reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes." If the Agency concludes that its action "would significantly restrict subsistence uses," it must notify the appropriate State agency, regional council, and local committee. It then must hold a hearing in the vicinity of the area involved, and must make three findings:

> that (A) such a significant restriction of subsistence uses is necessary, consistent with sound management principles for the utilization of public lands, (B) the proposed activity will involve the minimal amount of public lands necessary to accomplish the purpose of such use, occupancy, or other disposition, and (C) reasonable steps will be taken to minimize adverse impacts upon subsistence uses and resources resulting from such actions. 16 U.S.C. 3120(a)(3).

In People of the Village of Gambell v. Clark, 746 F.2d 572 (9th Cir. 1984) (Gambell I), the court ruled that the "lands and waters" of the OCS were "public lands" for the purpose of this section. The court later ruled that the provisions of section 810 should not be applied in a staged manner, despite the staged decisionmaking approach set out in the OCS Lands Act and relied upon by the Supreme Court in Secretary of the Interior v. California, 464 U.S. 312, 325-342 (1984). People of the Village of Gambell v. Hodel, Civ. No. 85-3877 (9th Cir. Oct. 25, 1985). As a result of these rulings, the Interior Department prepares an analysis under section 810 of ANILCA for lease sales and plans of exploration and development/production for activities offshore of Alaska. The provisions of ANILCA do not apply to the 5-Year Program at this stage because the Department does not make any of the prescribed decisions.

### c. OCS Orders

The OCS Orders are administered by the MMS and are designed to supplement regulations governing drilling and production operations. A summary of these Orders is presented below.

OCS Order No. 1. This Order requires identification of the operator, block designation, and well number on platforms, structures, wells, and mobile drilling units. It requires that the U.S. Coast Guard District Commander determine what aid-to-navigation devices are needed for subsea objects that are hazards to navigation or to the deployment of commercial fishing devices. It requires that equipment of sufficient size or of such a nature that it could be expected to interfere with commercial fishing gear, if dropped overboard, be marked, wherever practicable, with the owner's identification.

OCS Order No. 2. This Order details drilling operation rules and permit requirements including those for mobile drilling units (including fitness and ability to withstand oceanographic and meteorologic conditions). It includes criteria relative to well casing and cementing; blowout preventer equipment; mud program; supervision, surveillance, and training; and establishment of field drilling rules.

OCS Order No. 3. This Order establishes plugging and abandonment procedures which have general application to all wells drilled for oil and gas. All casings, wellhead equipment, and pilings must be removed to a depth of at least 5 m (15 feet) below the ocean floor unless another depth is approved by the Deputy Regional Director.

OCS Order No. 4. This Order sets forth criteria for demonstrating the capability of a well to produce paying quantities of oil or gas.

OCS Order No. 5. This Order deals with production safety systems on all OCS platforms and structures and regulates quality assurance, subsurface safety devices, and safety equipment. It requires plans, applications, and reports in the use of the best and safest technologies. Design, installation, and operation of pressure vessels, flow lines, and other safety equipment, as well as training, record keeping, failure reports, etc., are also regulated by this Order.

OCS Order No. 6. This Order sets specifications for workover procedures, including testing and wellhead fitting, valves, and casing heads. It relates to production operations only.

OCS Order No. 7. This Order requires that the lessee prevent pollution of the ocean, prescribe certain pollution control measures, and prohibit disposal of any waste materials into the ocean that will create conditions which will adversely affect the public health, life, property, aquatic life, wildlife, recreation, navigation, commercial fishing, or other uses of the ocean. Disposal of waste materials is regulated by EPA pursuant to the Clean Water Act.

OCS Order No. 8. This Order establishes requirements applicable to platform and structure design and installation. It requires consideration of environmental conditions which may contribute to structural damage. This Order applies to production operations.

OCS Order No. 9. This Order provides approval procedures for oil and gas pipelines on the OCS. All pipelines and related equipment must be designed and maintained with high-low pressure sensors, automatic shut-in valves, checkflow valves (to control backflow), and metering systems. This order also requires adequate provisions for cathodic corrosion protection, trawling compatibility, hydrostatic testing, storm scour, and other environmental stress in OCS pipelines. Procedures and schedules for regular inspection of pipelines, along with recordings of such inspections, are stipulated.

OCS Order No. 10. This Order relates specifically to sulphur drilling procedures regarding well casing and cementing, muds, and blowout prevention equipment. Specifics are given regarding drive or structural, conductor, and caprock casings; a general mud program is outlined for testing equipment and a monitoring system; and procedures are indicated for the installation and maintenance of blowout preventers and related well control equipment.

OCS Order No. 11. This Order sets requirements for the maximum efficient recovery rate for oil and gas from a lease and establishes production rates. It also provides procedures to shut-in wells, due to overproduction or storms, and for producibility tests. This Order applies to production only.

OCS Order No. 12. This Order sets forth requirements for public inspection of records. It details what information, which the lessee provides to MMS, is considered public and how this information should be transmitted to MMS in order for it to be made publicly available.

OCS Order No. 13. This Order specifies procedures for assuring the accurate measurement of oil and gas production and for commingling production from different leases or operators. The requirements will permit accurate determinations of Government royalties and an orderly transfer of production between parties.

OCS Order No 14. This Order establishes guidelines for the approval of suspensions of production and provides for diligent development of oil and gas resources. The intent of the Order is to allow sufficient time for proper lease development while prohibiting unnecessary delays in the exploitation of OCS resources. The environmental impacts of OCS development are minimized by proceeding in an orderly, well-planned fashion.

### 2. Other Federal Agency Responsibilities

#### a. U.S. Environmental Protection Agency

The FWPCA Amendments of 1972 (86 Stat. 816), created an NPDES which applies to discharges into the territorial seas, waters of the contiguous zone, and the oceans. The NPDES applies to fixed platforms and drillships, and discharges from these sources require an EPA permit. The CWA of 1977 (91 Stat. 1566) further amended the FWPCA to provide that lessees or operators may be held financially liable for damages due to oil spills. It provides for a liability of up to $50 million for actual costs of oil removal and cleanup (except where there is no fault of the operator or owner), as well as replacement or restoration costs of natural resources damaged or destroyed by a spill.

The EPA is also primarily responsible for facilities related to transportation, such as terminal and storage facilities. Permits for discharges by such facilities are issued by EPA or designated States according to established effluent guidelines.

Control of air emissions under the CAA applies to all OCS activities, including storage tanks, gas processing facilities, and other onshore OCS-related facilities involving point source emissions. In most cases, permitting authority under this Act has been delegated to the States, with oversight responsibility retained by EPA. The DOI has the sole responsibility for regulating emissions from facilities on the OCS.

### b. Army Corps of Engineers (Corps)

Section 10 of the River and Harbor Act of 1899 (30 Stat. 1151) prohibits construction of any structure in or over any navigable water of the United States, the excavation from or depositing of material in such waters, or the accomplishment of any other work affecting the course, location, condition, or capacity of such waters, unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of the Army. The authority of the Secretary of the Army to prevent obstructions to navigable waters of the United States was extended to artificial islands, installations, and other devices located on the OCS by section 4(e) of the OCSLA. Structures for the exploration, production, and transport of oil, gas, and minerals on the OCS within areas leased for such purposes by the MMS, are authorized by a Department of the Army nationwide general permit (33 CFR 330.5(a)(8)), provided those structures are not placed within the limits of any designated shipping safety fairway or traffic separation scheme and subject to the provisions of the fairway regulations in 33 CFR 209.135. The work must follow the special conditions contained in 33 CFR 330.5(b), and the Division Engineer may require individual authorization on a case-by-case basis at his discretion. In addition, the placement of pipelines and other related onshore activities in navigable waters of the United States would require authorization pursuant to section 10 of the River and Harbor Act of 1899, and the placement of dredged and/or fill material in waters of the United States for construction of related onshore facilities would require Department of the Army authorization pursuant to section 404 of the CAA.

### c. Department of Commerce

The Department of Commerce, through the NOAA, is responsible for the protection of marine fishery resources and their habitats, for administering the Coastal Zone Management and Coastal Energy Impact Programs, and for providing recommendations to the Corps of Engineers.

The Department's responsibilities and authorities related to OCS activities include those stemming from: the CZMA of 1972; the MPRSA Act of 1972, particularly as it relates to ocean dumping and marine sanctuaries; the Fishery Conservation and Management Act of 1976; the ESA of 1973; and the MMPA of 1972.

### d. Department of Transportation

The OCSLA grants authority to the U.S. Coast Guard to promulgate and enforce regulations covering lighting and warning devices, safety equipment, and other safety-related matters pertaining to life and property on fixed OCS platforms and drilling vessels. Through the Coast Guard, the Department of Transportation (DOT) advises the Corps of Engineers on the issuance of permits and the placement of offshore structures. Under the Ports and Waterways Safety Act, as amended (92 Stat. 1471), the Coast Guard has the authority to establish necessary fairways and traffic separation schemes in which OCS structures may be prohibited (See Section III.C.5).

Under the FWPA, the Coast Guard approves the procedures to be followed and the equipment used for the transfer of oil from vessel to vessel and between onshore and offshore facilities and vessels. The Coast Guard also conducts pollution and surveillance patrols to detect oil discharges within territorial and contiguous waters and has enforcement authority over violators. The Coast Guard also has strike team responsibilities should an oil spill occur (See Section IV.C.)

The Materials Transportation Bureau has the responsibility for establishing and enforcing design, constructing, operation, and maintenance regulations for pipelines downstream from the point of production or first processing. The DOT's responsibility and authority are defined in a Memorandum of Understanding between it and DOI.

### e. Department of Energy

The Federal Energy Regulatory Commission (FERC) within the Department of Energy has the authority under the Natural Gas Act (NGA) (52 Stat. 821) to issue certificates of public convenience and necessity for proposed projects involving the transportation or sale of natural gas for resale in interstate commerce. All natural gas produced from the OCS is considered to be interstate and, therefore, is subject to FERC jurisdiction.

The NGA, NEPA, and section 25(k) of the OCSLA all grant authority for or require that FERC investigate the environmental effects of a proposed offshore project, as well as the potential gas reserves, the need for the gas, and the availability of capital to develop the resource. Also, FERC is primarily responsible for administering and enforcing the Natural Gas Policy Act (NGPA) of 1978 (92 Stat. 3350). As applied to OCS matters, the NGPA provides new wellhead pricing controls for certain natural gas produced from the OCS.

### f. Interstate Commerce Commission

The Interstate Commerce Commission previously granted approval of the tariff rates for transportation of oil and common carrier pipelines. This authority was transferred to the FERC.

### g. Department of Labor

The OCSLA reiterates the authority of the Secretary of Labor to provide for the protection of occupational safety and health, and describes the jurisdiction applicable to offshore facilities under the National Labor Relations Act.

### h. Attorney General

The OCSLA provides that the Attorney General, in consultation with the Federal Trade Commission, shall comment with respect to preserving competition on regulations proposed by the Secretary of the Interior, on the acceptance of bids and issuance of leases, on pipeline permits, and on any proposed leasing program.

The Attorney General is authorized to comment on the assignment or transfer of OCS leasehold interest, may intervene in any court action under the OCSLA, may institute a civil action for enforcement of the OCSLA at the request of an authorized Federal Agency, may bring criminal action under the OCSLA, and may bring suit for payment in connection with the Offshore Oil Pollution Compensation Fund.

## E. Results of the Scoping Process

Scoping is a means for early identification of what are and what are not the important issues deserving of study in the EIS. The Council on Environmental Quality Regulations (40 CFR 1501.7) established a formal mechanism for agencies, in consultation with affected parties, to identify the issues that must be discussed in detail in an EIS. Thus, the scope of the EIS is established before the statement is written.

The scoping process for this EIS was initiated on March 22, 1985, with the publication of a Federal Register Notice of Intent to prepare an EIS. The scoping process consisted of, (1) a review of issues raised during the development of the 5-Year Leasing Schedule currently in effect, (2) a review of issues raised during the production of recently written EIS's in OCS planning areas, (3) evaluation of environmental information by Regional Office environmental staff specialists, and (4), an analysis of responses to the Notice of Intent and the issuance of the Draft Proposed Program.

### 1. Issues

The EIS has been organized so that concerns expressed by Federal Agencies, States, and the public are addressed under one of the following issues. The following discussions describe where each of the issues is discussed in this EIS.

Water Quality: This issue was raised in nine of the planning areas. In addition, concern has been expressed about the effects of oil spills and routine operational discharges, concerns which can also be considered as part of the issue of water quality. The water quality of the various planning areas is described in Chapter III. Impacts on water quality in each planning area from the proposal and alternatives are discussed in Chapter IV.B.4. Related discussions can also be found in Chapter IV.A.4., "Oil Spills," and IV.A.8.a, "Effluents and Discharges."

Ocean Dumping: The effects of OCS operations on ocean dumpsites, and the effects on water quality from operations within areas used as dumps were concerns in nine planning areas. Ocean dumping is described in Chapter III, for each planning area. The relationship of the proposal to ocean dumping in each planning area is described in Chapter IV.B.

Air Quality: Concern over the effects of the proposal on air quality was raised for a number of planning areas but was of most concern in four Pacific Coast planning areas. The issue is analyzed for every planning area in this document. Air quality is described in Chapter III, "Air Quality," for each planning area. The effects of the proposal on air quality are analyzed in Chapter IV.B, "Impacts on Air Quality," for each planning area. Additional analysis of the issue can be found in Chapter IV.A.4.d and IV.A.8.c.

Plankton: Plankton was not raised as a distinct issue. However, concern was expressed in 19 planning areas about the effects of oil spills and routine operational discharges, and as plankton could be affected by such impact causing factors, this document treats plankton as an issue. The subject is described in Chapter III for each planning area.

The issue is analyzed in Chapter IV.B in Section a(4) in each planning area discussion. Related discussions can be found in Chapter IV.A.4, "Oil Spills," and in IV.A.8.b, "Effects on Marine Life."

Benthos: Concern over benthic communities was raised in eight of the planning areas, mainly in relation to the effects of oil spills on the benthos. The benthos of each planning area is described in Chapter III for each planning area. Impacts on benthos are analyzed in Chapter IV.B for each planning area in Subsection a(4), "Impact on Benthos," and additional analysis can be found in Chapter IV.A.4. "Oil Spills," and IV.A.8.b, "Effects on Marine Life."

Fish Resources: Respondents to scoping raised concerns about the effects of offshore operations, oil spills, routine operational discharges, and possible destruction of wetlands and other coastal fish nursery habitats on the fish resources relied upon by commercial fishermen. Respondents from 19 of the planning areas expressed concerns about the fish resources in their planning areas. The fish resources of each planning area are described in Chapter III. Impacts are analyzed Chapter IV.B, for each planning area in Subsection a(4). Related analysis can be found in Chapter IV.A.4, "Oil Spills," and in Chapter IV.A.8, "Effluents and Discharges."

Marine Mammals: Concerns about marine mammals were expressed in 19 of the planning areas. Concerns raised were the effects of an oil spill on the animals themselves, on coastal habitats of the mammals, and the effects on subsistence hunting and whaling which relies on the animals. Both marine mammals and subsistence hunting in Alaska were discerned as issues. Subsistence hunting is discussed later in this section. Marine mammals in each planning area are described in Chapter III. An analysis of the possible impacts on the animals from this proposal and each of the alternatives is provided in Chapter IV.B. Additional related analysis can be found under the Subsections entitled: "Impact on Endangered and Threatened Species" and, Impact on Marine Sanctuaries" in Chapter IV.B and under "Oil Spills", and "Noise and Other Disturbances" in Chapter IV.A.

Coastal and Marine Birds: In 17 of the planning areas, concerns were raised about the effects of an oil spill on coastal and marine birds; on the effects of the proposal on estuaries, wetlands, and other coastal habitats for birds; and on the effects of OCS related transportation activity on bird nesting areas. A description of birds and their habitats is given in Chapter III for each planning area. An analysis of the impacts of this proposal on them is given in Chapter IV.B in Subsection a(4) for each planning area. Additional analysis can be found in Wetlands", Chapter IV.A.4, "Oil spills," and Chapter IV.A.7, "Noise and other Disturbances."

Endangered and Threatened Species: This issue and related concerns were raised in 20 of the planning areas. Respondents were concerned about the effects of oil spills on the species themselves and on their habitats, and also about the effects of noise and other OCS-related disturbances. These species are described in Chapter III. An analysis of the impacts of the proposal is presented in Chapter IV.B. in subsections entitled "Impact on Endangered and Threatened Species", in section a.(4)(f). Related analysis can be found in Chapter IV.A.4, "Oil Spills," and IV.A.7, "Noise and Other Disturbances".

Estuaries and Wetlands: Concerns about estuaries and wetlands were raised in nine of the planning areas, and numerous concerns about other topics were related to this issue. The effects of oil spills, pipeline construction, and coastal industrial expansion on coastal areas, and the effects of the loss or alteration of estuaries and wetlands on fish resources, marine mammals, coastal and marine birds, and marine sanctuaries were all mentioned in relation to this issue. Estuaries and wetlands are described by planning area in Chapter III. Impacts on these resources are analyzed in Chapter IV.B in section a.(4), for each planning area. Related analysis is presented in Chapter IV.A.4. "Oil Spills."

Areas of Special Concern: These areas were mentioned in relation to nine planning areas. Concerns were that these areas could be affected by oil spills or OCS-related traffic, or that the animal life within them could be adversely affected. These areas are described in Chapter III for each planning area containing such areas. Analysis of potential impacts is discussed in Chapter IV.B, under "Impact to Areas of Special Concern." Additional analysis related to these areas can be found in Chapter IV.A.4, "Oil Spills," and in Chapter IV.A.7, "Noise and Other Disturbances."

Marine Sanctuaries: Concerns about possible impacts to marine sanctuaries were raised in nine of the planning areas. Respondents stated that some of these areas could be affected by oil spills, by anchoring or other bottom disturbing activities related to OCS operations, or that species using the sanctuaries could be affected by OCS operations. Marine sanctuaries are described, for those planning areas containing them, in Chapter III. Analysis of potential impacts are discussed for each appropriate planning area in Chapter IV.B. Related analysis can be found in Chapter IV.A.4, "Oil Spills," IV.A.5, "Manmade Structures," IV.A.7, "Noise and other Disturbance."

Employment and Demographic Conditions: Respondents in 17 planning areas raised concerns related to employment and demographic conditions ranging from OCS operations causing "boom and bust" conditions, straining present public services, to the fact that increased population could cause increased hunting pressure on game. Current employment and demographics are described in Chapter III. Impact analysis takes place in Chapter IV.B, in Subsection a(5)(a) for each planning area. Related information can be found in Chapter IV.A.9, "Socioeconomic Assumptions."

Coastal Land Uses and Water Services: This issue was a concern mostly in the Gulf of Mexico and on the West Coast. Respondents in eight planning areas mentioned concerns related to this issue. Replies to scoping brought up the building of refineries and support bases and attendant zoning and land use changes, the effects of industrial growth in the coastal zone on coastal habitats and wetlands, and the effects of coastal growth on water supplies and quality. The issue is described in Chapter III for each planning area. Analysis of impacts can be found in Chapter IV.B, "Impact on Coastal Land Use and Water Services," in the Section a(3) of each planning area analysis.

Coastal Zone Management: Coastal zone management concerns in itself, were raised by some commenters. Relationships of this proposal to coastal zone management plans is discussed in Chapter IV.B.a(1) for each planning area.

Commercial Fisheries: Respondents from 19 of the planning areas were concerned about commercial fisheries. The effects of oil spills, routine operational discharges, placement of rigs and platforms in fishing areas, and the effects on fish resources from changes in wetlands and estuaries were all mentioned as concerns. The industry is described in Chapter III for each planning area having such fisheries. The effects of the proposal on this industry are analyzed in Chapter IV.B, "Impact on Commercial Fisheries," in Subsection a(5)(d), for each planning area. Related analysis can be found in Chapter IV.B, Subsection a(4)(c), "Impact on Fish Resources," and Chapter IV.A, Subsection 4, "Oil Spills," and Subsection 6, "Vessel Traffic."

Recreation and Tourism: This was raised as an issue in 10 of the planning areas. Respondents were concerned mainly about the effects of oil spills and debris on tourist beaches and the effect of offshore rigs and platforms on the visual aspect of coastlines. A description can be found in Chapter III. An analysis of impacts can be found in Chapter IV.B, in Section a(5) for each planning area.

Archaeological Resources: Archaeological resources were mentioned in nine of the planning areas. The principle concern was that activities which disturb the ocean bottom would damage prehistoric dwelling sites or shipwrecks. A description of the resource in each planning area can be found in Chapter III. Impacts on these resources are discussed in Chapter IV.B, in Subsection a(5), for each planning area.

Marine Vessel Traffic and Offshore Infrastructure: This topic is discussed because respondents in numerous planning areas mentioned concerns about the effects of OCS related vessel traffic on commercial fisheries and on vessel traffic and transportation corridors. A description of current levels can be found in Chapter III. Impacts on marine traffic and offshore oil and gas infrastructure can be found in Chapter IV.B, in Section a(5), for each planning area.

Military Uses: Concerns were expressed in eight planning areas about the effects of offshore operations on military and National Aeronautics and Space Administration (NASA) use of OCS areas. A description of current levels of military and NASA use can be found in Chapter III. An analysis of impacts expected from this proposal can be found in Chapter IV.B, in Subsection a(5)(h), "Impact on Military Uses" for appropriate planning areas.

Native Subsistence: This topic applies to Alaska planning areas and is in response to concerns from 11 Alaska planning areas about the effects of the proposal on subsistence hunting, fishing and whaling. The subject is described in Chapter III. Impact analysis can be found in "Impact on Native Subsistence" in Chapter IV.B.11-21. Related analysis can be found in the Alaska planning area discussions on Impact on Sociocultural Systems.

Sociocultural Systems: This topic was also raised as a concern in the Alaska planning areas. The topic is described in Chapter III. Impact analysis of the proposal on this topic can be found in "Impact on Sociocultural Systems" in Chapter IV.B, Sections 11 to 21, Subsection a(5). Related analysis can be found in Alaska planning area discussions on "Impact on Native Subsistence."

### 2. Alternatives

During the development of a 5-year leasing program proposal, a program which requires that decisions be made on a schedule of lease sales, on the configuration of planning areas, and on a presale process which will determine the size of sales, it would be possible to identify a myriad of alternatives for each of these three aspects of the proposal. However, the number of alternatives which can be given thorough consideration is limited by reasons of practicality. Therefore, an effort has been made, following consideration of comments received on the Draft Proposed Program and scoping comments, to formulate a proposal and identify a reasonable number of alternatives which address the range of concerns expressed in these comments.

#### a. Alternative I - The Proposed Action

The Proposed Action includes: a determination of planning area boundaries within which sale proposals will be formulated, and identification of 14 subareas in 6 planning areas which are proposed to be deferred from leasing in this 5-year program. (A 15th subarea, the Atlantic coast portion of the Straits of Florida, was also deferred from any consideration for leasing in this 5-year program. See Alternative III.); a schedule of sales (annual sales in the Central and Western Gulf of Mexico, triennial sales in 14 other planning areas, 5 other sales in Alaska planning areas, and 5 annual supplemental sales); designation of certain sales as frontier exploration sales and others as subject to an acceleration provision; and a presale system designed to focus lease sale offerings on promising acreage. The formulation of the proposal in this manner thus responds to concerns expressed for a slower pace of leasing (the current 5-year program is based generally on a biennial pace of leasing outside the Central and Western Gulf of Mexico). It also contains the provisions necessary to ensure sufficient flexibility to adapt the schedule to the Nation's energy needs. The presale system which focuses on promising acreage (described in detail in

Section II.A.1.a and Appendix I) responds to concerns raised regarding early identification and resolution of environmental issues, while not unnecessarily limiting industry's opportunities to explore. The promising acreage presale system emphasizes the early resolution of environmental issues, thus incorporating that feature of the tract selection presale system by which environmental concerns were taken into consideration prior to selection of tracts for further study in the EIS. The inclusion in the Proposed Action of the deferral of 14 subareas responds in part to comments received on the Draft Proposed Program requesting the deferral of such areas. Further consideration of this issue is provided under Alternative II.

The following alternatives retain all features of Alternative I except as noted.

### b. Alternative II - Subarea Deferrals

The March 22, 1985, Federal Register Notice announcing the Draft Proposed Program contained a request for comments as to whether subareas within planning areas should be given special consideration during development of the 5-year program or during the presale process for specific lease sales. Numerous comments were received requesting deferral of subareas from the new 5-year program in response to both the Notice and the July 1984 Notice announcing the start of the program development process. Each of these subareas, in addition to certain NASA and Department of Defense use areas, were described, and the potential impacts which would be avoided should they be deferred were evaluated (this evaluation is included as Attachment 5 to the SID for the Proposed Program). Upon consideration of the subarea issue, the Secretary proposed to defer 15 subareas from leasing during the 5-year program (see Alternatives I and III). In addition, the Secretary identified 13 other subareas which will be subject to further analysis and comment before a decision is made as to their disposition in the 5-year program. Impacts which would be avoided by deferral of these 13 subareas are discussed in Alternative II.

### c. Alternative III - Add a Sale in the Straits of Florida

Evaluation of this alternative provides consideration of the effects of holding a sale in that planning area. The Atlantic Coast portion of this planning area extending to about 42 miles south of Miami has been deferred from consideration for leasing in this 5-year program. Only the remaining portion of the planning area could be considered for leasing. Some respondents from the oil and gas industry were concerned that exploration for oil and gas resources not be restricted by current evaluations of hydrocarbon potential, and that all planning areas should be given consideration. The State of Florida also expressed concern about establishing a planning area in the Straits of Florida. This alternative will provide information on the effects of including a sale in the remaining portion of the Straits of Florida planning area.

### d. Alternative IV - Biennial Sales in Planning Areas which have Triennial Sales under Alternative I

This alternative is analyzed to address the concerns of those who think the pace of exploration for oil and gas resources on the OCS should proceed in a more rapid manner. This alternative retains the annual pace of leasing in the Central and Western Gulf of Mexico, but explores the effects of having a more rapid pace of leasing in the 14 planning areas where triennial sales are scheduled in Alternative I.

#### e. Alternative V - Apply the Acceleration Provision to All Planning Areas which have Triennial Sales Under Alternative I

This alternative evaluates the environmental effects of implementing an acceleration provision should it be determined that national energy needs warrant an acceleration of leasing. For analytical purposes, it is assumed that leasing is accelerated to a biennial pace, but no sales would be added to the number scheduled per planning area in Alternative I. Analysis of this alternative responds to the concern that the 5-year program incorporate sufficient flexibility to adjust to major unforeseen developments regarding the Nation's energy needs.

#### f. Alternative VI - Defer Leasing in Six Planning Areas: The North Atlantic, Southern, Central, and Northern California, Washington/Oregon, and the North Aleutian Basin

This alternative was designed to provide analysis of the effects of having a 5-year leasing schedule which has no sales in those areas in which a number of respondents recommended that no leasing take place, and to respond in part to those who wish to see a slower paced leasing program.

#### g. Alternative VII - No Action

This alternative required by CEQ regulations (40 CFR 1502.14(d)), discusses the effect of choosing a course of no action, i.e., implementing no new 5-year leasing program. This alternative references Appendix C, which discusses the environmental effects of alternative energy sources.

### 3. Issues and Alternatives Eliminated from Further Study in this EIS

#### a. Issues

Although a wide range of issues has been identified as appropriate for analysis in this EIS, some issues raised during the scoping process were eliminated from further study in this EIS. The issue of phased development was raised by some commenters. Phased development is taken to mean the phasing of approval of development/production plans in a planning area in order to regulate the number of production activities in place at any one time, thereby reducing the potential impact on the environment at any one time. This issue is not given detailed consideration in this EIS. Decisions on the approval of development/production plans and incorporating appropriate mitigating measures are not under consideration in this proposal. Approval of the 5-year program requires that decisions be made regarding a schedule of sales, configuration of planning areas, and a presale process to determine the size of sales.

Similarly, the implementation of specific mitigating measures, i.e., lease stipulations, is not given detailed study in this EIS. Several suggestions were received that the 5-year EIS should examine the implementation of such specific mitigating measures. The attachment of stipulations to leases is, however, a matter that is appropriate for decision and is, therefore, given thorough consideration during the presale process for each OCS lease sale. Mitigating measures that are already in place and which will apply to all OCS leases, i.e., regulations and OCS orders, are discussed in Section I.D.

#### b. Alternatives

The Secretarial Issue Document (SID) describes focusing on promising acreage as "a flexible approach whose results can range from areawide size sales to tract selection size sales depending on MMS resource estimates, industry nominations, environmental issues, and use conflicts. For this reason, because the new program will itself contain substantial subarea deferrals from leasing, and because it is extremely difficult to project with any accuracy what the difference in sale sizes or configurations for the acreage remaining in the program may be under a promising acreage presale system as opposed to a tract selection or areawide presale system, neither an areawide nor a tract selection presale system has been treated as a separate alternative.

A suggestion was made that planning areas be reduced to 2-3 million acres in size. The EIS does not address this as an alternative. The division of the potential hydrocarbon-bearing areas of the OCS into 2-3 million acre planning areas would result in an unmanageable number of planning areas, making the 5-year planning process even more complex and time consuming than it currently is. Neither would a large increase in the number of planning areas in itself contribute to the ability of affected States to plan effectively for lease sales and their resulting effects. Rather than treat this suggestion as an alternative, the EIS includes under Alternative I a presale system that is designed to involve the participation of affected States at an early stage in the presale process, so that sale proposals can be developed giving consideration to the States concerns, and environmental issues can be identified and resolved early on. A similar response is appropriate for other suggestions received to increase or decrease the number of planning areas or to realign their boundaries. Rather than examining numerous alternative planning area configurations as a means of improving the presale planning process, a presale planning process focusing on promising acreage has been incorporated into the proposed action, and additionally, subarea deferrals have been made under Alternative I and are given further consideration under Alternative II.

## F. Environmental Studies

### 1. Objectives

The objective of the OCS Environmental Studies Program (ESP) is to "establish information needed for prediction, assessment, and management of impacts on the OCS and the nearshore area which may be affected . . . ." (43 CFR 3001.7). The studies are designed to:

(1) Provide information on the status of the environment upon which the prediction of the impacts of OCS oil and gas development may be based.

(2) Provide information on the ways and extent that OCS development can potentially impact the human, marine, biological, and coastal area.

(3) Ensure that information already available or being collected under the program is in a form that can be used in the decisionmaking process associated with a specific leasing action or with the longer term OCS mineral management responsibilities.

(4) Provide a basis for future monitoring of OCS operations.

The purpose of the studies program is to ensure that the environmental information on which decisions are based is the most definitive that can be assembled at the time.

### 2. Relationship of the Environmental Studies Program to the Leasing Process

The MMS offshore leasing program is a primary determinant of studies information needs. There are many steps in the leasing process which require environmental information. Prelease events include Area Identification, draft and final EIS's, public hearings, and preparation of the SID. Additional postlease events that require environmental data and assessment are exploration plans, drilling permitting, transportation plans, development and production plans, pipeline permitting, and lease termination or expiration.

At each step of the offshore lease management process, a variety of potential resource use conflicts may be encountered. Consequently, basic management questions serve to further define the information needs that environmental studies must address. To focus the studies, several multiple-use conflict questions have been formulated. Two basic questions are fundamental: (1) What is the expected reduction in benefits derived from man's use of the environment due to major multiple-use conflicts of the proposal) and, (2) Can this loss be minimized by mitigating measures? Use conflicts include subsistence living, commercial fishing, recreation, social infrastructure, ecological relationships, air and water quality, archaeological and historic resources, shipping conflicts, and environmental hazards to technology.

The 5-year lease sale schedule remains the major consideration for the design and management of the studies program. To support the proposed 5-year lease schedule, a 5-year management plan will be developed for the

ESP. This plan will consider the priorities for leasing expressed in the proposed 5-year leasing schedule, the environmental issues related to that schedule, the existing environmental data available through the ESP and in the open scientific literature and existing programmatic guidance for program management. The ideal e in a frontier area, provides a minimum 4-year period preceding a lease sale to obtain information needed for an assessment of potential offshore impacts. For most second and third generation lease

sales, a shorter period is plausible. It is apparent that not all informational needs can be obtained prior to a lease sale. Since oil and gas production usually occurs 8 to 15 years after leasing, postlease studies may continue to address environmental concerns and acquire additional information for the development and production phase EIS's.

A formal assessment of regional and national information needs occurs annually. Regional Study Plans (RSP's) are developed which identify existing and potential offshore management decisions and related regional information needs, the regional perspective on the priorities of these needs and a brief description of rationale for specific studies to address the identified needs. Development of the current fiscal year RSP is begun 2 years in advance. Regions solicit information from local, State, and Federal Agencies and academic, industry, and environmental organizations to assist in the formulation of issues of concern which may warrant further study. The OCS Advisory Board Regional Technical Working Groups and Scientific Committee contribute to this early identification of study issues. Draft RSP's are prepared based on this collective imput and are distributed widely for review prior to the preparation of the final RSP.

A set of criteria have been developed to provide an orderly process for determining which proposed studies would be funded during any fiscal year. These criteria consider the following topics:

(1) The MMS's mandate for conducting the study.

(2) Time available for conducting of study before scheduled leasing or lease management decisions.

(3) Applicability of study results, methodology, or technology to other OCS areas.

(4) Present availability and completeness of the data.

(5) Regional and/or programmatic importance of study issue.

A National Studies List is prepared using the identified criteria which represents the sum of all environmental studies that will be procured during the identified fiscal year. These studies are the initiated during the identified fiscal year to collect information needed for the various resource management decisions identified in the RSP.

## 3. History and Current Trends

The OCS ESP was initiated in 1973 to support DOI's OCS Oil and Gas Leasing Program. During 1973 to 1978, the OCS ESP consisted primarily of baseline and monitoring studies that were designed based on information developed through literature syntheses on the environmental and socioeconomic characteristics of the OCS leasing areas and supplemented by special studies of selected sites or topics of special interest. The baseline studies were large-scale, multidisciplinary studies designed to characterize the nature, abundance, and diversity of animal and plant populations, the physical characteristics of the seafloor and overlying marine waters, and the concentrations of certain trace metals and hydrocarbons in the water, sediments, and selected biota prior to any OCS oil and gas activity in an area. A series of monitoring studies, in concept, followed each baseline study to provide information on changes in measurable environmental characteristics relative to the baseline data as OCS oil and gas activities proceeded in each study area.

In 1977, this baseline approach reviewed by decisionmakers who determined that the program was not providing timely and appropriate information for leasing decisions and by scientists who advised that the marine environment was too variable for a statistically valid baseline to be determined in a reasonable length of time. The Bureau of Land Management (BLM) began a major effort to restructure the environmental studies planning such that the information needs of the OCS minerals management decisionmaking process would drive the OCS ESP. The National Research Council was contracted to study the existing program and to recommend changes. Subsequent to the NRC review, the BLM issued a program management document entitled "Study Design for Resource Management Decisions: OCS Oil and Gas Development and the Environment (October 1978)" which restructured the Environmental Studies Program and required a clear relation between a study and OCS issues and decisions. That guidance continues to be in effect today.

Appendix H, "Environmental Studies" provides a general overview of the objectives and accomplishments for each of the regional programs and the Washington office. Timeliness provided for the major program areas give an indication of continuing emphases in the regional programs.

Since 1981 a growing emphasis in the program has been toward a better understanding of oceanographic processes that influence the long-term cumulative impacts of OCS oil and gas development activities. These studies will be integrated closely with the monitoring programs currently being implemented in support of increased development activity in the Pacific and Alaskan Regions. Coastal wetland loss rates and processes are being studied in the Gulf of Mexico Region as potential nearshore/onshore impacts continue to receive greater attention. Increased emphasis is also being placed on socioeconomic studies in the Gulf and Pacific Regions. Socioeconomic and cultural resource studies continue to be a stable component in the Alaskan Region.

Since 1982 increased emphasis has also been given to information dissemination and management. Support for publication of results in peer-reviewed journals, information syntheses, and reviews of knowledge will continue in all program areas. Additionally, the National Research Council will occasionally assist in this area as it did on the effects of drilling mud discharges.

## 4. Information Distribution

Information gathered through the OCS ESP is received from the various contractors in the forms of reports, maps, computer tapes, or other records. Copies of all study products are maintained by the Regional Offices for their use, and copies of the reports are distributed to appropriate Federal and State agencies, repository libraries, and some limited general distribution organizations. Reports are made available to the general public through the National Technical Information Service (NTIS), and data are made available through the National Oceanographic Data Center of the Environmental Data and Information Service of the Department of Commerce.

The MMS Regions hold various scientific meetings on a regular basis to transfer up-to-date information to inhouse staff personnel and the interested public, other Government Agencies, and industry. These meetings take place as synthesis meetings for specific lease sales, technical workshops, and Information Transfer Meetings. The degree of public involvement depends on the type of meeting.

The OC ESP provides a significant source of information needed for the many stages of the decisionmaking process for management of OCS resources. This information is used for development of the programmatic EISs upon which the 5-Year OCS Oil and Gas Leasing Schedule is based, for development of regional environmental profiles and OCS EISs and other NEPA documents, for evaluation of plans for exploration and development, and for planning other studies conducted by the MMS. The information is also used by numerous other persons in private industry, academic institutions, and Federal, State, or other government agencies for many purposes.

# II. ALTERNATIVES INCLUDING THE PROPOSED ACTION

## A. Analysis of Alternatives

### 1. Alternative I - The Proposed Action

#### a. Description of the Proposal

The proposed action is the adoption, pursuant to section 18 of the Outer Continental Shelf Lands Act (OCSLA), as amended, of a 5-year OCS oil and gas leasing program for the years 1987 through 1991 (as described in the Proposed Program which was forwarded by the Secretary in early 1986, to the Governor of each affected State, the Attorney General, Congress, and appropriate Federal Agencies for their review and comment). The formulation of a leasing program requires that decisions be made regarding a leasing schedule, the configuration of planning areas, and a presale process which leads to decisions on the size of individual lease sales.

#### (1) The Schedule

Over the period 1987 through 1991, the Proposed Program provides for 27 standard sales, 10 frontier exploration sales, and 5 annual supplemental sales (see Table II.A.1.a-1) for a total of 42 sales. Thirty-seven of these proposed sales would be single planning area sales where the size is determined by focusing on promising acrage, while the proposed 5 annual supplemental sales would be relatively small sales consisting of a few tracts in one or more planning areas.

This contrasts with the current program (as approved in July 1982), which provided for 40 standard sales and 1 reoffering sale. The new schedule proposes the continuation of annual sales in the two highest-value, highest-interest areas: the Central and Western Gulf of Mexico. It proposes triennial sales in 14 other areas. This triennial pacing of sales contrasts with the biennial pace in the current 5-year program.

The first OCS sale since 1964 is proposed for 1991 offshore Washington and Oregon given the value of that area's resources and industry interest. The sale for this area is proposed for late in the 5-year period to allow time for the necessary environmental studies to be performed.

Base Schedule: The base schedule proposes 27 standard sales in 13 planning areas. Eight of these standard sales are sales carried over from the current to the new program.

The schedule proposes no sales in St. Matthew-Hall, Aleutian Arc, Aleutian Basin, and Bowers Basin so as to concentrate management resources on other areas with higher resource potential and industry interest.

Frontier Exploration Sales: Ten frontier exploration sales are proposed offshore Alaska, the Atlantic, and Washington and Oregon to increase the flexibility of the schedule to respond to changes in prices and other economic conditions or improved geologic and geophysical data. These ten

## Table II.A.1.a-1
## Current Leasing Schedule Overlap with the Proposed Program
## (Base Schedule + 10 Frontier Exploration Sales)

| | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | No. of Sales |
|---|---|---|---|---|---|---|---|---|---|---|
| ATLANTIC********************************************************** | | | | | | | | | | 4 |
| North | | 82 | | | | 96[S+] | | | S+ | |
| Mid- | 76 | | | 111 | | | S+ | | | |
| South | 78 | | | 90 | | | 108[S+] | | | |
| GULF OF MEXICO********************** | | | | | ****************************** | | | | | 12 |
| Western | 74 | 84 | 102 | 105 | S | S | S | S | S | |
| Central | 72 | 81 | 98 | 104 | 110 | S | S | S | S | |
| Eastern | 69(II) | 79 | 94 | | | S | | | S | |
| PACIFIC****************************** | | | | | ****************************** | | | | | 6 |
| Southern CA | | 80 | | | 95 | | | S | | |
| Central CA | 73 | | | | | | S | | | |
| Northern CA | | | | | | 91 | | | S | |
| Washington-Oregon | | | | | | | | | S+ | |
| ALASKA******************************* | | | | | ****************************** | | | | | 15 |
| Beaufort Sea | | 87 | | | 97 | | | S | | |
| Chukchi Sea | | | | | 109 | | | S | | |
| Norton Basin | 57 | | | 100 | | | S | | | |
| Navarin Basin | | 83 | | | 107 | | | S | | |
| St. George Basin | 70 | | | 89 | | | 101 | | | |
| N. Aleutian Basin | | | | 92 | | | S | | | |
| Shumagin | | | | | | 86 | | | S+ | |
| Gulf of Alaska | | | | | | S+ | | | | |
| Cook Inlet | | | | | | | | | S+ | |
| Kodiak | | | | | | | | | S+ | |
| Hope | | | | | | | | | S+ | |

Total - 37

Total (including supplemental sales) - 42

Sales to the left of the vertical line are in the current 5-year leasing schedule. Sales to the right of the vertical line are included in the Proposed Program.

S = Sale not yet numbered. Sale numbers are those in the 1982 program.
S+ = Frontier Exploration Sale.

Note: This schedule has been prepared using the latest available information. Administrative considerations may delay the holding of a number of sales. If such a change occurs, the leasing schedule will be implemented so as to factor in that change consistent with the scheduling policy selected by the Secretary.

sales are proposed for the Gulf of Alaska (1988), Cook Inlet (1991), Shumagin (1991), Hope Basin (1991), Kodiak (1991), North Atlantic (1988 and 1991), Mid-Atlantic (1989), South Atlantic (1989), and Washington and Oregon (1991). (The 1987 Shumagin sale, Sale 86, regarding which a poll of industry interest was taken in 1984, is carried over from the current schedule as a standard sale. In these frontier areas, the assessment of oil and gas resources is incomplete, and at this time, industry interest appears low. Sales 96 (North Atlantic) and 108 (South Atlantic) are sales carried over from the current schedule, which are now designated as frontier exploration sales.

These frontier exploration sales will include an additional presale step: a Request for Interest scheduled for 4 months prior to the Call for Information and Nominations. Responses to each Request will be used to help determine whether the approximately 2-year sale process should proceed in those areas. The annual review of the program under section 18(e) will also be used to determine whether to proceed with these sales. For purposes of analysis in this EIS, these sales are assumed to be held as scheduled.

Supplemental sales: The schedule also includes an annual sale for a limited number of selected blocks in areas other than the Central and Western Gulf of Mexico: drainage and development blocks and blocks on which bids were rejected in the preceding year. These sales will provide for: (1) the expeditious offering of blocks in which serious industry interest can be reasonably anticipated, (2) orderly development of OCS resources (increasing the potential for actual development and reducing the time necessary to bring new fields into production), and (3) minimization of costs of delay. These blocks will only be offered after compliance with the requirements of the National Environmental Policy Act (NEPA), the OCSLA, and other applicable statutes. To comply with NEPA, an environmental assessment (EA) would be written on these drainage, development, and rejected block sales. If each of the tracts had been covered in an EIS within the last several years, the preparation of an EA regarding the leasing of these tracts could well be sufficient to comply with the requirements of NEPA. However, it may be necessary to prepare a new EIS or a supplemental EIS if the EA finds that significant additional environmental information has become available, or environmental impacts are identified which were not evaluated in a recent EIS. In this case, the subject tracts could be dropped from consideration in the supplemental sale, or an EIS could be prepared regarding these tracts prior to including them in a supplemental sale in the following year. The environmental documentation for each of these sales would be released prior to the Proposed Notice of Sale. If it is determined that an EIS is required for one of these sales, revised presale milestones will be issued. It is expected that supplemental sales would contain relatively few tracts. Since the largest structure on the OCS covers only approximately 35 blocks, even if an entire structure were offered, the number of drainage and devel-opment tracts offered would likely be very small compared to the size of a standard sale. It is impossible to anticipate, at this time, how many blocks and even which planning areas would be involved in each supplemental sale. Therefore, no separate resource or infrastructure estimates for supplemental sales have been prepared. In this EIS, potential environmental impacts of proposed supplemental sales are not quantitatively distinguished from impacts of the 37 promising acreage sales in the proposal. However, the potential impacts of these supplemental sales are assumed to fall within the range of impacts projected for the proposal and Alternative IV-Biennial Leasing.

Acceleration provision: The DOI must plan for an unknown future with limited information. Changes in the world energy market as well as exploration results in frontier areas can dramatically affect the demand for offshore leases. The statutory requirement to develop "a schedule of proposed lease sales indicating, as precisely as possible, the size, timing, and location of leasing which [the Secretary] determines will best meet national energy needs for the 5-year period following its approval . . ." must be applied with due recognition that what will be known tomorrow may very well be different from what is known today.

To comply fully with the statutory requirement to meet national energy needs over the 5 years of the program, the proposed schedule should have the flexibility to respond to changing conditions. Thus, the new Proposed Program includes a provision to accelerate sales in eight planning areas of higher value and/or higher interest (but not so as to increase the total number of sales in any planning area in the approved program). The areas where such acceleration would be considered include: Southern California, Eastern Gulf of Mexico, Central California, Northern California, Navarin Basin, Beaufort Sea, North Aleutian Basin, and St. George Basin.

In the interest of analytical clarity, the environmental analysis of the proposal is based on the annual pace of leasing in the Central and Western Gulf of Mexico, a triennial pace of leasing in 14 other planning areas, and 6 other sales in the Alaska planning areas (see Table II.A.1.a-1). The effects of invoking the acceleration provision in the subject eight planning areas, as well as in other planning areas, is evaluated in Alternative V.

The flexibility provision would be used only if warranted by changes in economic conditions (for example, substantially higher oil price expectations such as might result from a serious oil supply disruption) or geologic data (such as could come from major new discoveries). The question of whether to accelerate a sale in an area would be made on a sale-by-sale basis, as part of the required review of the program under section 18(e). No new sales would be added to the program in any planning areas under this provision.

### (2) Size of Lease Sales

It is proposed that the size of lease sales be determined by a presale process which focuses on promising acreage. Focusing on promising acreage is a flexible approach whose results can range from small, "tract selection" size lease sales to larger sales. The results of the process will depend on MMS resource estimates, industry nominations, environmental issues, and use conflicts. Focusing on promising acreage also incorporates a consultative process designed to provide for the early resolution of conflicts with State and local governments and other parties.

Focusing on promising acreage modifies the areawide leasing approach by providing for the tailoring of Call areas on a case-by-case basis to exclude parts of the planning area. Focusing on promising acreage also modifies the areawide approach by soliciting nominations for leasing.

In both the areawide and focusing approaches, potential bidders are asked to outline areas or tracts in the planning area, within or beyond the area of hydrocarbon potential depicted by MMS in the Call, which they believe to have hydrocarbon potential and in which they might be interested in leasing. All interested parties are requested to comment on possible environmental effects and use conflicts. The scope of the information obtained by MMS ranges from broad area information to tract-specific information. In the focusing approach, other information may be solicited in a more precise form. For example, information from potential bidders has been requested on areas which had been deleted in past sales in the same area.

The Area Identification step is a formal decision on the area whose offering is analyzed as the proposed action in the EIS. The information received from the Call, along with other information, is used to decide what areas, if any, should be deferred from further consideration at that point. In this fashion, focusing on promising acreage resembles the tract selection presale system, in that information regarding environmental issues and use conflict is used in the early focusing of the proposed action.

The MMS uses the responses from potential bidders to identify promising acreage, taking into account the collective judgment of the oil and gas industry as well as its own. In the case of the initial areawide approach, MMS added to that a broad area outline. The focusing approach, in part, concentrates more on geological basins as identified by MMS and industry responses to the Call, deleting areas where MMS sees no hydrocarbon potential or, where appropriate, resolves conflicts that have been identified. For example, 61.2 million acres were deferred in the Area Identification decision for Sale 111, Mid-Atlantic.

It is illustrative of the flexibility of focusing on promising acreage that the decision on the proposed Notice of Sale for Sale 94 reduced its area from the over 50 million acres identified for study to about 37 million acres, based on coordination with affected States and other parties. Projections of future outcomes regarding sale sizes, however, cannot be performed with great precision because the "presale process" is an abstraction whose concrete implementation can lead to very different results in different planning areas. The results of the presale process are likely to differ both between planning areas and between sales in the same planning area because they depend on the following variable factors: (1) MMS and industry estimates of the amount and distribution of undiscovered oil and gas resources in an area; (2) environmental and multiple-use considerations; and (3) the results of consultations with numerous parties, including coastal State Governors, under section 19 of the OCSLA. All three factors are subject to different perceptions by the various parties who participate in the offshore leasing process.

The presale process presents opportunities to receive information on and to conduct consultations concerning multiple-use and environmental considerations. Decisions on the size of the Call area and the Area Identification provide the occasion for the early resolution of conflicts over these issues. The focusing approach emphasizes the use of these early decision points to resolve such conflicts that cannot be mitigated through other means--especially with respect to low-resource, low-interest blocks.

The EIS's for sale proposals under the focusing on promising acreage approach will continue to evaluate deferral options as well as measures (such as stipulations) to mitigate potential advance impacts of development. See Appendix I for a step-by-step discussion of the presale process.

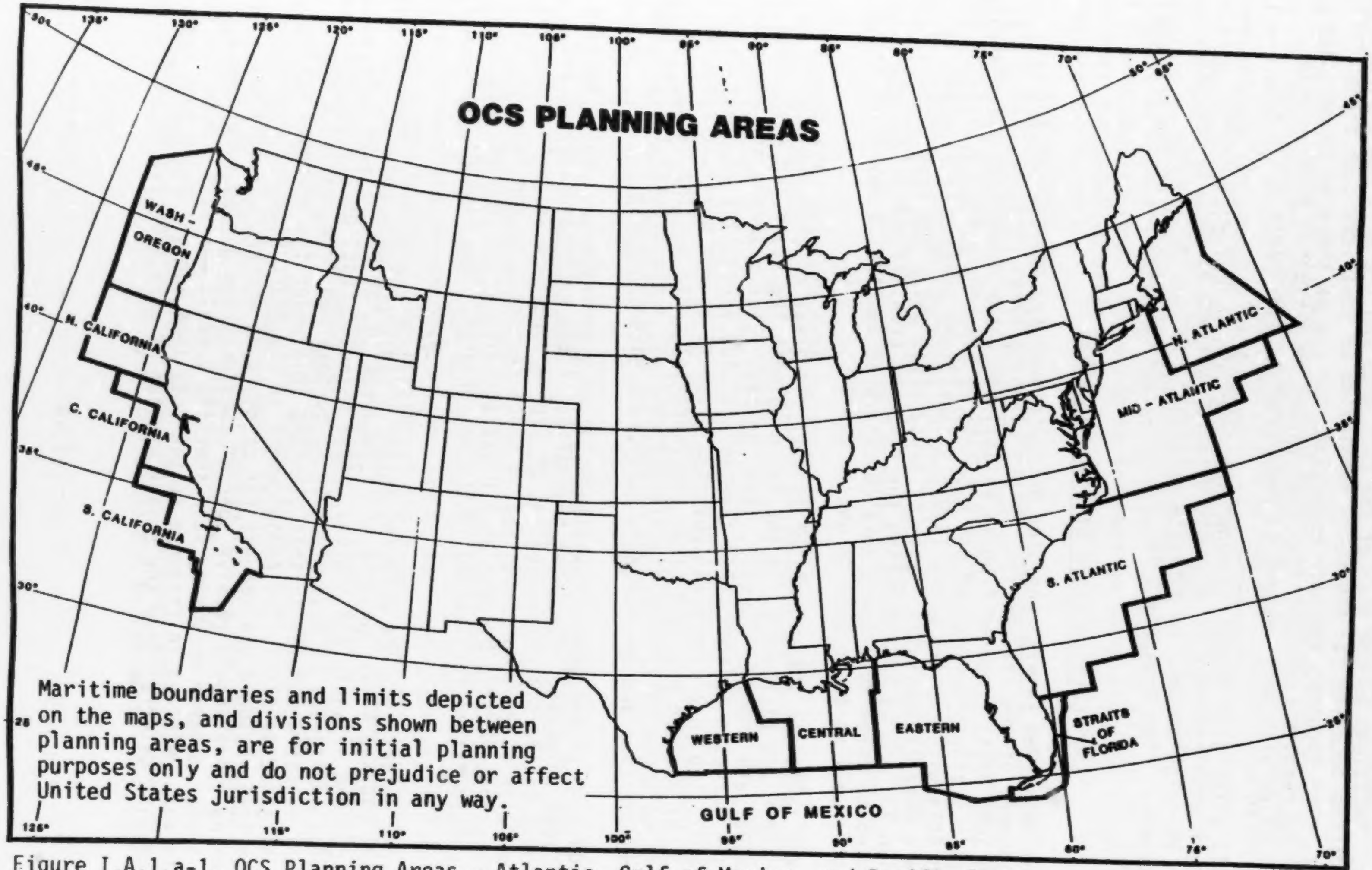
### (3) Configuration of Planning Areas

In the July 1984 Federal Register Notice requesting comments on the development of the new program, 24 OCS planning areas were depicted. The March 1985 Draft Proposed Program established outer boundaries for planning areas. It also reconfigured the OCS into 26 planning areas by dividing the South Atlantic into two areas (South Atlantic and Straits of Florida) to allow a more concentrated review of those areas under the provisions of section 18; and by reconfiguring the planning areas offshore California from two to three to allow a more concentrated section 18 review of those areas as well as to respond to public comment.

The key factor in the reconfiguration of the areas offshore California is that there are discoveries in the basin on both the south and west sides of Santa Barbara County. It will, thus, be better for planning and administrative purposes to treat them together for the scheduling of lease sales and analyzing in a single EIS potential impacts on air quality, transportation of oil and gas, and other environmental factors. The other four basins offshore California are divided equally, i.e., two and two, to form the new central and new northern California planning areas.

In addition to the above reconfiguration of planning areas, outer boundaries were selected. The outer boundaries f the Washington-Oregon and Northern California areas were set at 128° W longitude so as to encompass the area of hydrocarbon potential in those regions. In the Beaufort Sea, Official Protraction Diagram BS 7-8 was added so as to include that area for consideration for leasing in the new program. See Figures II.A.1.a-1 and II.A.1.a-2.

Subarea deferrals: The proposed action includes the deferral from leasing during the new 5-year program of 14 subareas in the Pacific, Gulf of Mexico, and Atlantic OCS Regions. (The Atlantic coast portion of the Straits of Florida is also proposed to be deferred from leasing although a sale is not scheduled in that planning area under the Proposed Action. See Alternative III.) The announcement of the Draft Proposed Program in March 1985 included the request for comments on whether any subareas within planning areas should receive special consideration during development of the 5-year program or during sale-specific presale analysis. Numerous comments were received in response to the July 1984 and the March 1985 Notices requesting deferral from the 5-year program of many subareas of particular



Maritime boundaries and limits depicted on the maps, and divisions shown between planning areas, are for initial planning purposes only and do not prejudice or affect United States jurisdiction in any way.

Figure I.A.1.a-1. OCS Planning Areas - Atlantic, Gulf of Mexico, and Pacific Regions.

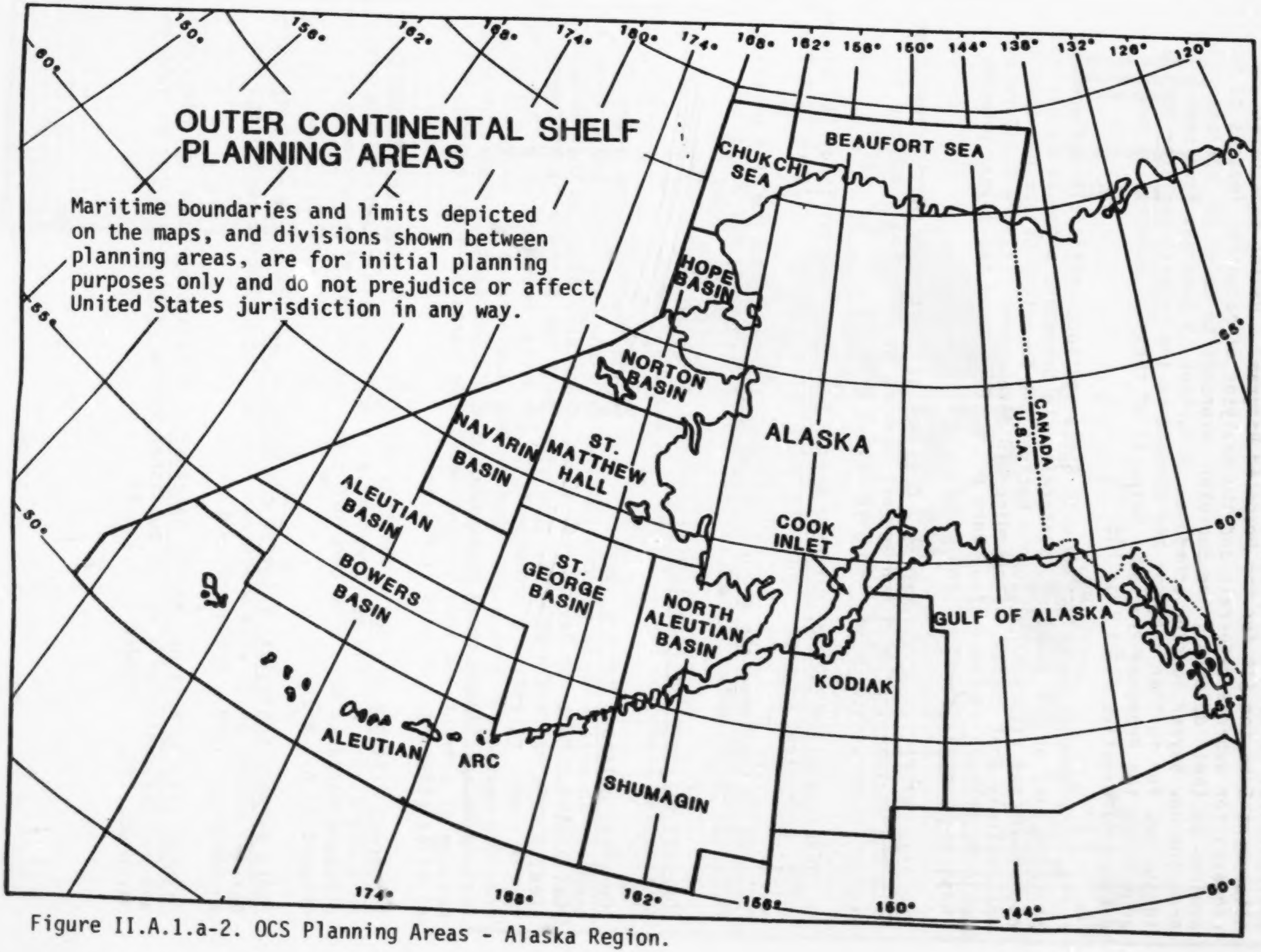


Figure II.A.1.a-2. OCS Planning Areas - Alaska Region.

environmental concern or use conflicts. (These subareas are described in Attachment 5 to the SID for the Proposed Program). Having considered the requests for subarea deferrals and the analyses of potential impacts to be avoided by their deferral, the Secretary proposes to defer 14 subareas from the new 5-year leasing schedule. A further 13 subareas have been identified for further analysis and comment in the Federal Register Notice announcing the Proposed Program. Deferral of these 13 subareas is evaluated in Alternative II of this EIS.

Following extensive consultation with State and local officials and members of the public of the State of California, the Secretary proposes to exclude eight subareas offshore California because the Secretary determined that it was unlikely that consensus regarding OCS development offshore California could be reached if these areas were not excluded from the 5-year program. These eight areas are described below.

The area off Pt. Reyes Wilderness - Consists of 110 blocks and is consistent with the statutory prohibition against leasing in this area contained in section 11(h) of the OCSLA. (Figure II.A.1.a-3)

Pt. Reyes-Farallon Islands National Marine Sanctuary - Consists of 157 blocks and is consistent with the sanctuary established by NOAA. (Figure II.A.1.a-3).

The area in the immediate vicinity of Cordell Bank - Consists of 8 blocks that encompass the 91-meter isobath of this area. (Figure II.A.1.a-3).

The area offshore San Francisco Bay - Consists of 17 blocks immediately outside San Francisco Bay. (Figure II.A.1.a-3)

The areas offshore Monterey Bay - Consist of 104 blocks. These areas comprise an Area A which extends 10 miles from the California coast from just north of Monterey Bay to just south of Monterey Bay. In this 10-mile area, a deferral would be made, consistent with the Secretary's statement in the summer of 1985 and because of the potential small effect on the view from the coast. In Area B off Monterey Bay, the deferral is extended to include an additional area, consistent with the Secretary's statement and because of current low industry interest. The combined areas extend 48 miles offshore. (Figure II.A.1.a-3).

The areas offshore Big Sur - Consists of 460 blocks. These areas comprise an A and B zone for the same reasons as discussed with respect to the areas offshore Monterey Bay. The combined areas extend 131 miles offshore. (Figure II.A.1.a-3).

Santa Barbara Ecological Preserve and Buffer Zone - Consists of 15 full and partial blocks which were withdrawn from leasing by Public Land Order 4587 on March 21, 1969. (Figure II.A.1.a-4).

Channel Islands National Marine Sanctuary - Consists of about 175 blocks and was designated by a Notice published in the Federal Register by NOAA on March 30, 1981. (Figure II.A.1.a-4).

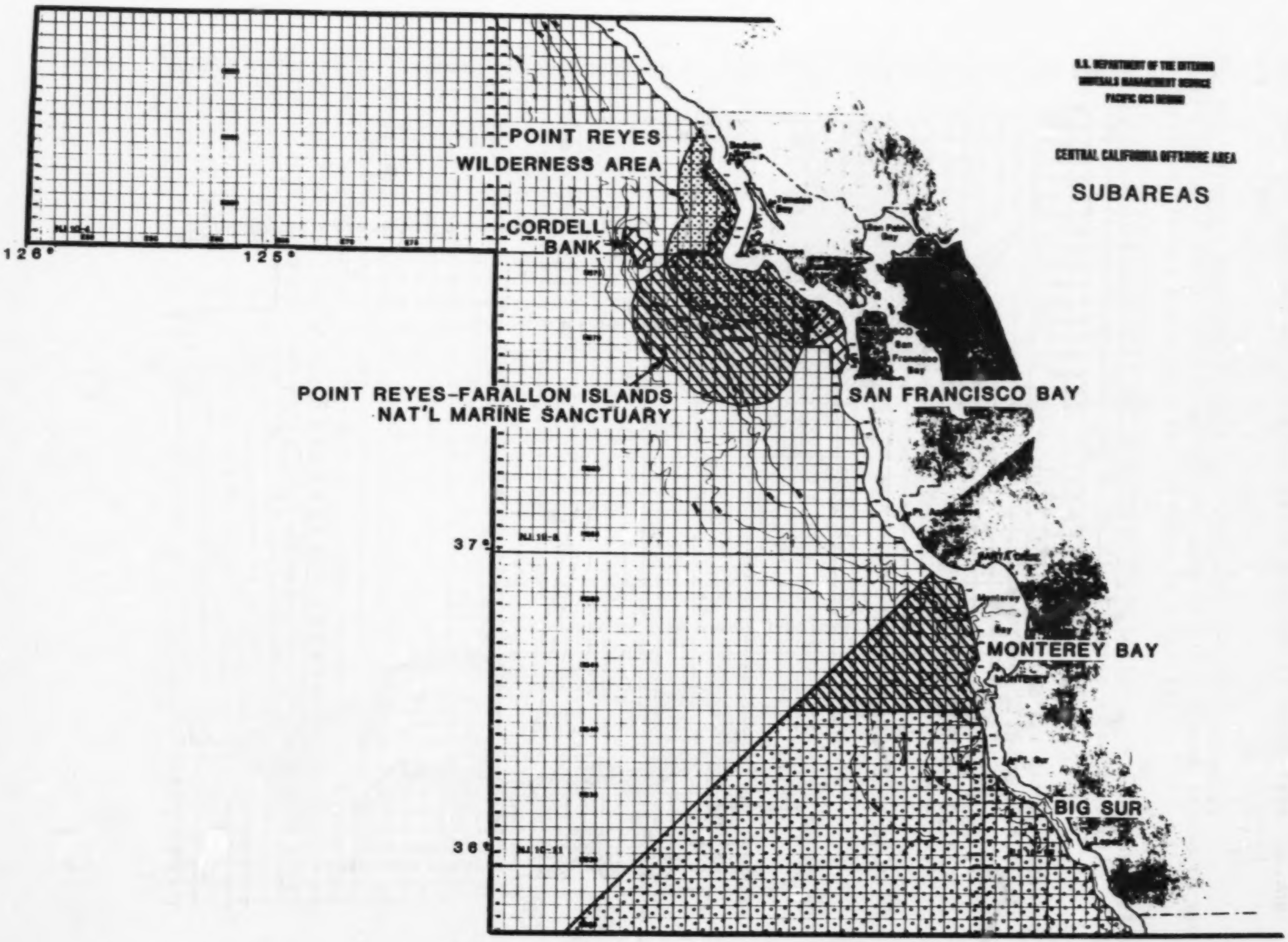


Figure II.A.1.a-3. Proposed Subarea Deferrals - Central California Planning Area.

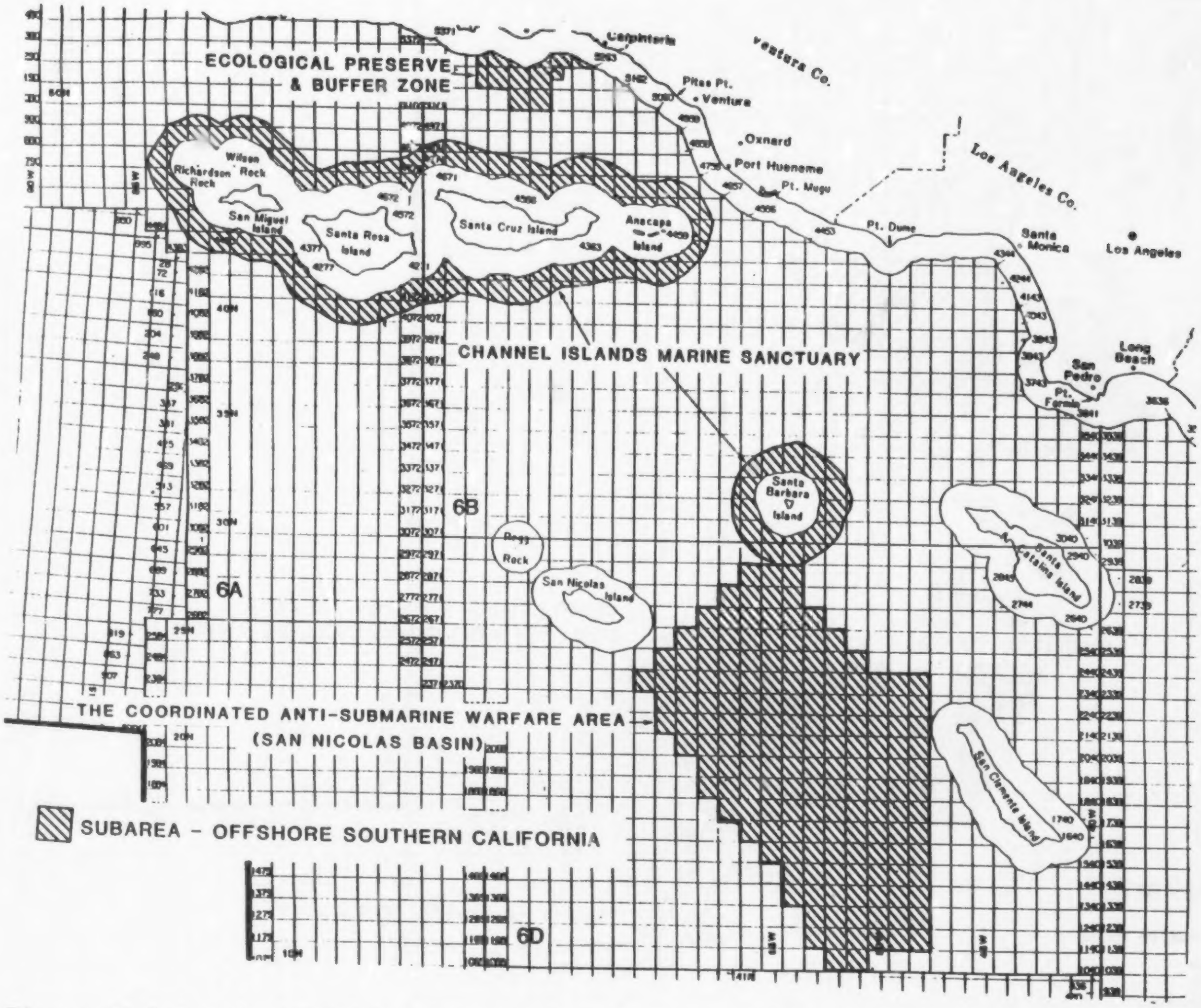


Figure II.A.1.a-4. Proposed Subarea Deferrals - Southern California Planning Area.

The other six subareas which the Secretary proposes to defer from leasing are as follows:

The San Nicholas Navy Operating Area - Consists of 160 contiguous blocks south of Santa Barbara Island and west of San Clemente Island in the Southern California planning area. (Figure II.A.1.a-4).

The U.S.S. Monitor National Marine Sanctuary and Buffer Zone - Consists of six blocks offshore North Carolina in the Mid-Atlantic planning area. (Figure II.A.1.a-5).

Gray's Reef National Marine Sanctuary - Consists of the six blocks occupied by the sanctuary in the South Atlantic planning area. (Figure II.A.1.a-6).

Seagrass Beds Offshore Florida - Consists of 186 blocks in the area of seagrass beds offshore the west coast of Florida in the Eastern Gulf of Mexico planning area. (Figure II.A.1.a-7).

Florida Middle Ground - Consists of 23 blocks in the Eastern Gulf of Mexico planning area. (Figure II.A.1.a-7).

Flower Garden Banks - Consists of two blocks covering coral reef formations in the Western Gulf of Mexico planning area. (Figure II.A.1.a-8).

The potential impacts which may be avoided by deferral of leasing in these subareas are described in Section IV.B under the analysis of impacts of Alternative I for the appropriate planning areas.

### b. Resource Estimates and Exploration and Development Information

#### (1) Resource Estimates

The resource estimates used in this EIS are conditional estimates which assume the presence of economically developable hydrocarbons. The environmental impact analysis in this EIS assumes the leasing and development of oil and gas resources in the amount estimated. The resource estimates for the proposal are the percentage of the conditional developable resources in each planning area that can be expected to be leased and developed as a result of the sales on this schedule.

In March 1985, the regional geologic assessments of resource potential were completed, and using the model Prohibilistic Resource Estimates Offshore (PRESTO), estimates of conditional undiscovered, economically recoverable resources and their associated marginal probabilities were derived for each planning area for use in the 5-year program analyses. These PRESTO evaluations were based on economic conditions and projections as of the beginning of 1984. They were also based on identified geologic prospects and, due to gaps in the data in certain planning areas or limitations in the analysis of the data, the PRESTO evaluations were supplemented with hypothetical or postulated prospects which were created from empirical geologic data in analog areas and extrapolations of known trends.

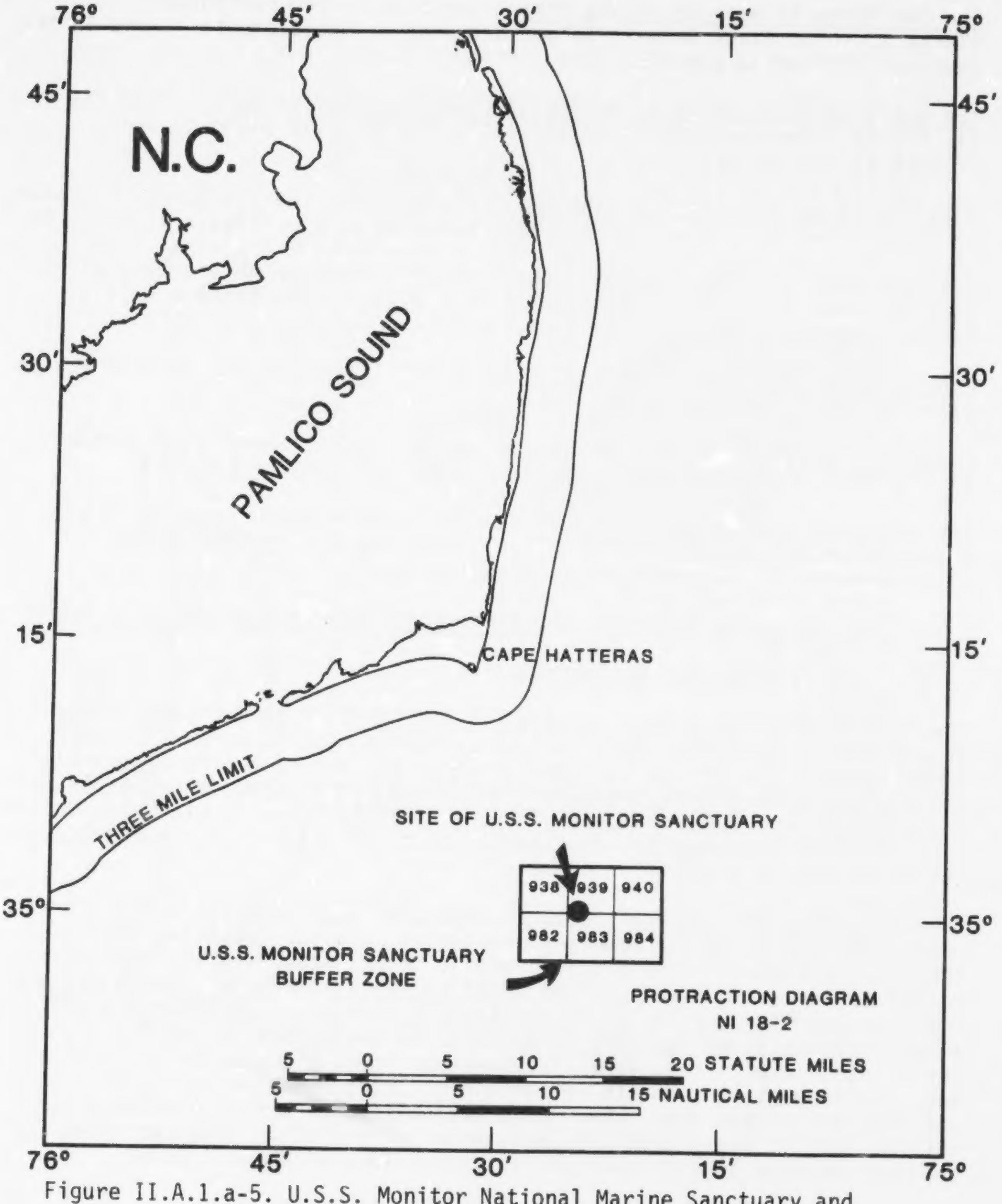


Figure II.A.1.a-5. U.S.S. Monitor National Marine Sanctuary and Buffer Zone Proposed Subarea Deferral.

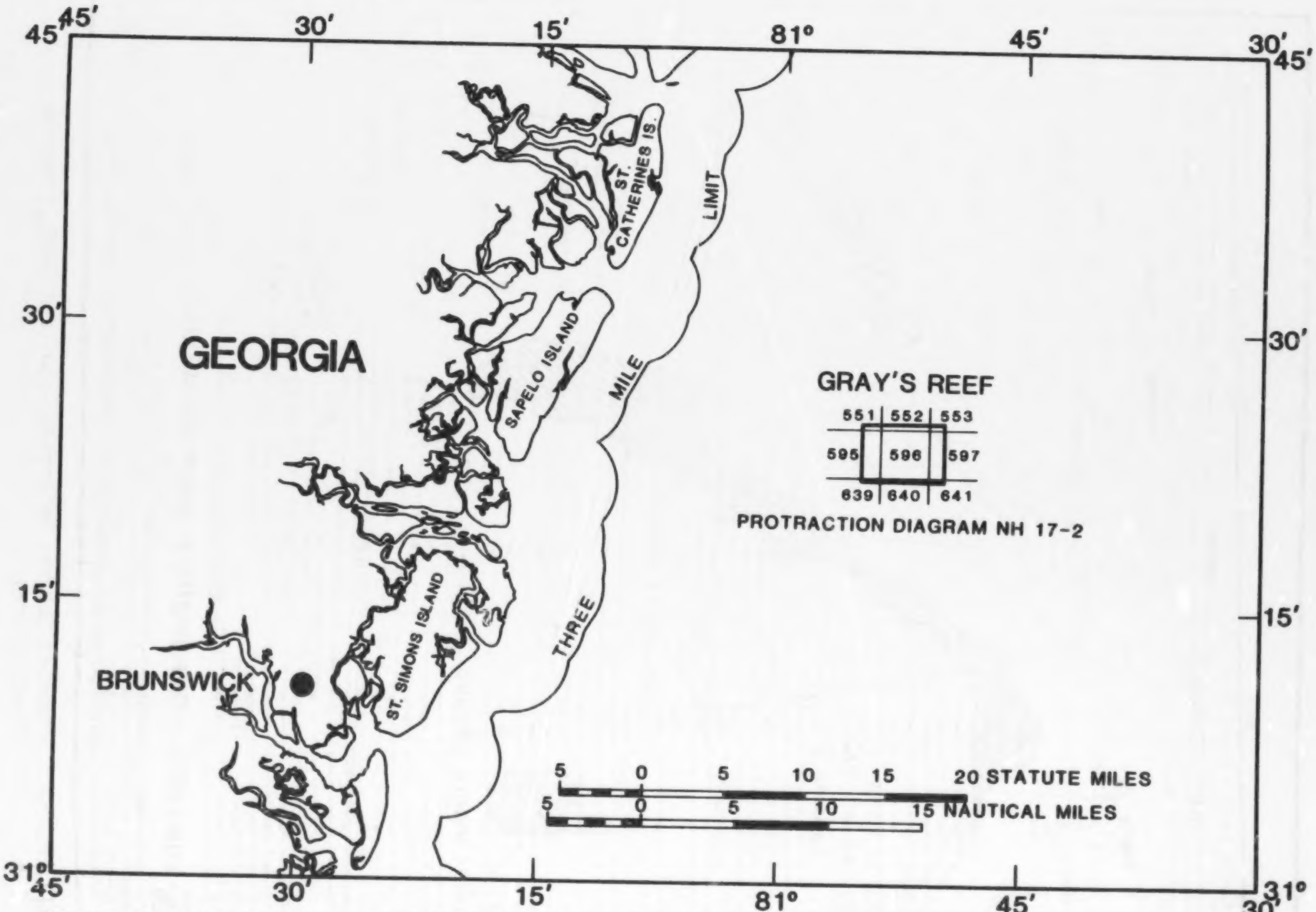


Figure II.A.1.a-6. Gray's Reef National Marine Sanctuary Proposed Subarea Deferral.

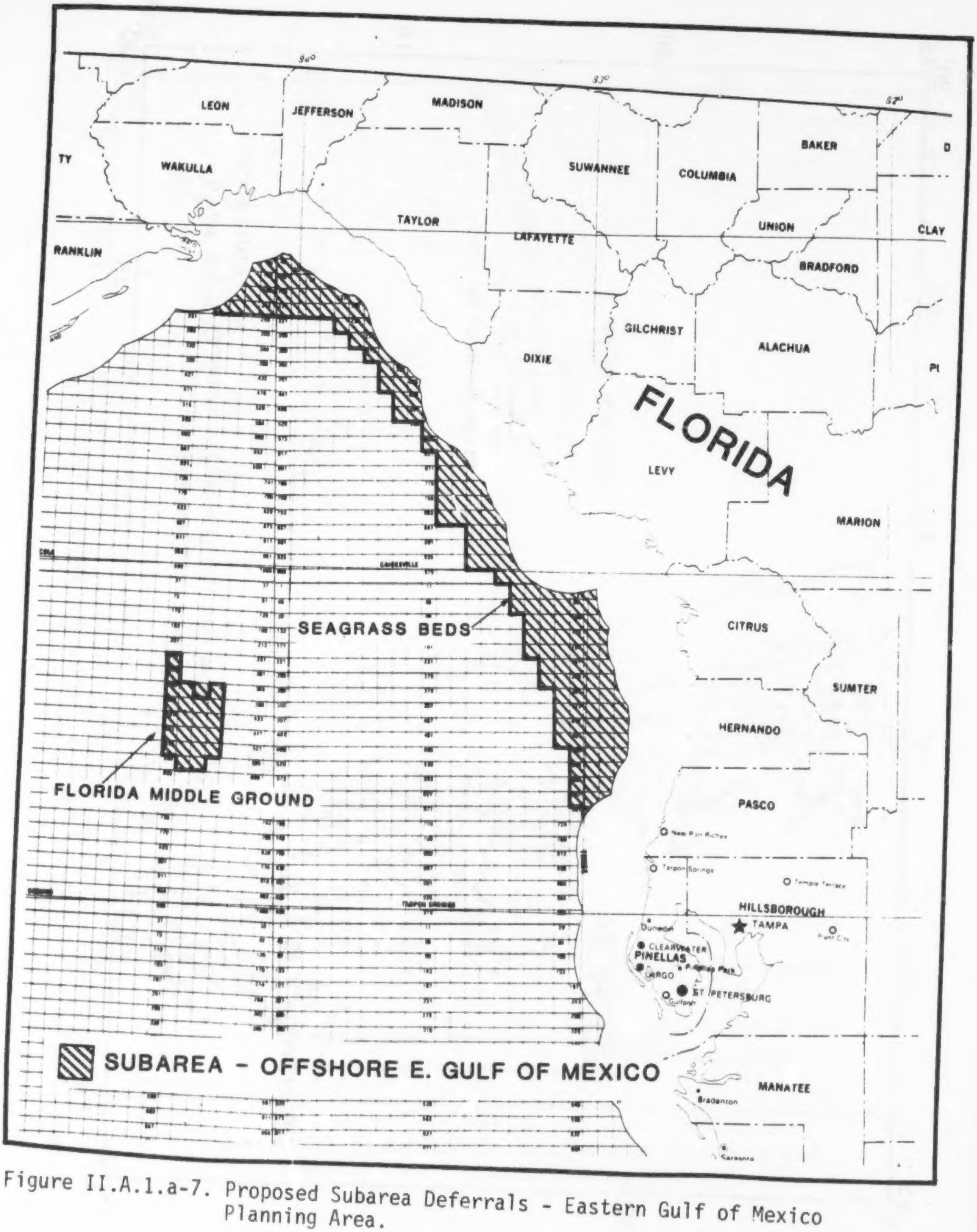


Figure II.A.1.a-7. Proposed Subarea Deferrals - Eastern Gulf of Mexico Planning Area.

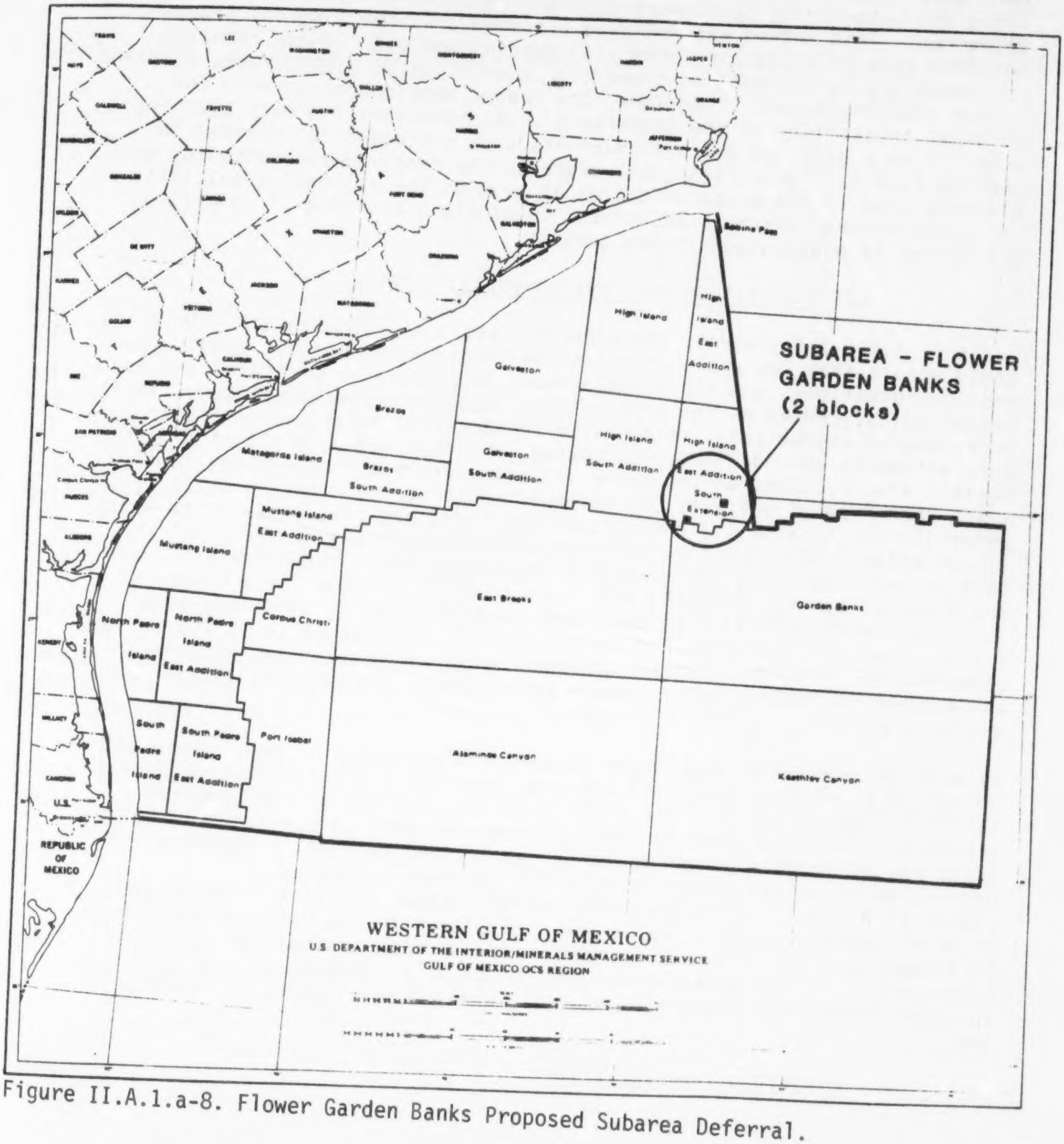

SUBAREA - FLOWER GARDEN BANKS (2 blocks)
Sabine Pass
High Island
High Island East Addition
Galveston
Brazos
Galveston South Addition
High Island South Addition
High Island East Addition South Extension
Matagorda Island
Brazos South Addition
Mustang Island East Addition
Mustang Island
East Breaks
Garden Banks
North Padre Island
North Padre Island East Addition
Corpus Christi
South Padre Island
South Padre Island East Addition
Port Isabel
Alaminos Canyon
Keathley Canyon
U.S.
REPUBLIC OF MEXICO
WESTERN GULF OF MEXICO
U.S. DEPARTMENT OF THE INTERIOR/MINERALS MANAGEMENT SERVICE
GULF OF MEXICO OCS REGION

Figure II.A.1.a-8. Flower Garden Banks Proposed Subarea Deferral.

Percentages of the PRESTO mean resource estimates were subsequently allocated to each sale in the proposal and alternatives and to intervening sales to be held prior to the beginning of the 5-year program (1/1/87). The total leased and unleased PRESTO resource estimates per planning area were used in predicting sale-by-sale percentages of resources. The leased lands and intervening sales were also allocated percentages of the total resources. This method was followed assuming that the marginal probability for each sale in a planning area will remain constant. These resource estimates are conditional on commercial quantities of hydrocarbons existing in the planning areas. Therefore, the reader should bear in mind the marginal probability of the occurrence of hydrocarbons for each planning area. A more detailed discussion of resource estimates is included in Section IV.A.1. Table II.A.1.b-1 presents the resource estimates for each planning area in the proposed action as well as the regional probability for hydrocarbons, which is an indication of the likelihood of commerical quantities of hydrocarbons being present.

### (2) Exploration and Development Information

Table II.A.1.b-2 represents the expected levels of offshore activity which could result from the exploration and delineation of possible hydrocarbon bearing formations, and the establishment of production platforms and associated wells. Based on the sale-by-sale resource percentages, conditional undiscovered economically recoverable resource estimates, and infrastructure estimates were derived, aggregated, and reported on a planning area basis. Also included on the table are the estimated time periods during which each type of activity can be expected to occur, a period which generally starts with the drilling of the first exploratory well, at least 1 year after the first sale, and ends with the drilling of the final production wells up to 25 years later. Production and maintenance activity and platform removal activity would, of course, continue for a number of years beyond the drilling of the final production well. The life of a field, after all platforms are on production, could be up to 35 years. See also Chapter IV.A. for further information on exploration and development assumptions including drilling muds and cuttings, onshore facilities, and oil spills.

It must be remembered that these numbers are estimates of development based on estimates of resources, and are developed for evaluating the potential levels of impacts which might occur from the adoption of the proposed schedule. The likelihood of the listed development levels actually taking place may be roughly judged by referring to the "Marginal Probability of Hydrocarbons" column presented with the resource estimates in (Table II.A.1.b-1). For instance, the projection of 18 exploratory and 26 development/production wells and 2 platforms in the North Atlantic must be viewed in light of the 30 percent chance of the presence of commercial hydrocarbons in the area (70 percent chance of no commercial hydrocarbons). In other words, the likelihood of this level of development is relatively low.

### c. Projected Transportation

Table II.A.1.b-1

Conditional oil and gas resource estimates for the Proposal (Alternative 1)

| Planning Area | No. Sales | Conditional Resources | | Million BOE | Marginal Probability of Commercial Hydrocarbons |
|---|---|---|---|---|---|
| | | Oil (Million bbls) | Gas (BCF) | | |
| N. Atlantic | 2 | 49 | 961 | 220 | 0.30 |
| Mid-Atlantic | 1 | 25 | 419 | 100 | 1.00 |
| S. Atlantic | 1 | 69 | 1294 | 299 | 0.25 |
| W. Gulf of Mexico | 5 | 437 | 6155 | 1532 | 1.00 |
| C. Gulf of Mexico | 5 | 1004 | 8286 | 2479 | 1.00 |
| E. Gulf of Mexico | 2 | 62 | 329 | 120 | 1.00 |
| S. California | 2 | 462 | 726 | 591 | 1.00 |
| C. California | 1 | 207 | 292 | 259 | 0.65 |
| N. California | 2 | 231 | 1023 | 413 | 0.60 |
| Washington/Oregon | 1 | 58 | 1043 | 243 | 0.20 |
| Beaufort Sea | 2 | 627 | | 627 | 0.70 |
| Chukchi Sea | 2 | 1152 | | 1152 | 0.20 |
| Norton | 1 | 102 | 470 | 186 | 0.15 |
| Navarin | 2 | 1920 | 2336 | 2336 | 0.27 |
| St. George | 1 | 135 | 1261 | 360 | 0.22 |
| N. Aleutian | 1 | 173 | 1258 | 397 | 0.20 |
| Shumagin | 2 | 48 | 1362 | 291 | 0.03 |
| Gulf of Alaska | 1 | 113 | 1751 | 425 | 0.08 |
| Cook Inlet | 1 | 179 | 298 | 231 | 0.03 |
| Kodiak | 1 | 95 | 1840 | 422 | 0.05 |
| Hope | 1 | 145 | 1539 | 418 | 0.02 |
| Totals | 37 | 3,596* | 19,057* | 6,987* | |

*These are totals of risked developable resource estimates and not the sums of conditional resource estimates in the columns above. See Section IV.A.1. for discussion of aggregation of resource estimates.

## Table II.A.1.b-2
## Exploration and Development Activity Resulting from the Proposed Program

| Planning Area | No. Exploratory and Delineation Wells | No. Development/ Production Wells | No. Platforms | Exploration & Delineation Wells First Year | Exploration & Delineation Wells Last Year | Exploration & Delineation Wells Period of most intense activity | Platforms First Year | Platforms Last Year | Platforms Period of most intense activity | Development/Production Wells First Year | Development/Production Wells Last Year | Development/Production Wells Period of most intense activity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N. Atlantic | 18 | 26 | 2 | 1990 | 1994 | 1992 | 1997 | 1997 | 1997 | 1998 | 2000 | 1998 |
| Mid-Atlantic | 9 | 11 | 1 | 1991 | 1993 | 1991-93 | 1996 | 1996 | 1996 | 1997 | 1998 | 1997 |
| S. Atlantic | 11 | 35 | 1 | 1991 | 1993 | 1992-93 | 1996 | 1996 | 1996 | 1997 | 1999 | 1997-98 |
| W. Gulf of Mexico | 713 | 912 | 76 | 1988 | 2000 | 1992-96 | 1992 | 2005 | 1995-98 | 1992 | 2006 | 1996-98 |
| C. Gulf of Mexico | 1246 | 1596 | 133 | 1988 | 2001 | 1992-97 | 1992 | 2005 | 1996-99 | 1992 | 2006 | 1997-99 |
| E. Gulf of Mexico | 19 | 36 | 2 | 1990 | 1995 | 1990-94 | 1995 | 1998 | 1995,1998 | 1996 | 2001 | 1996-2000 |
| S. California | 207 | 475 | 10 | 1988 | 1995 | 1991-93 | 1992 | 1997 | 1994-96 | 1992 | 1999 | 1996 |
| C. California | 11 | 30 | 1 | 1991 | 1993 | 1992-93 | 1996 | 1996 | 1996 | 1997 | 1999 | 1997-98 |
| N. California | 20 | 48 | 2 | 1990 | 1994 | 1992 | 1997 | 1997 | 1997 | 1998 | 2001 | 1998-99 |
| Washington/Oregon | 10 | 29 | 1 | 1993 | 1995 | 1995 | 1998 | 1998 | 1998 | 1999 | 2001 | 1999-2000 |
| Beaufort Sea | 22 | 61 | 2 | 1989 | 1994 | 1991 | 1998 | 1998 | 1998 | 1999 | 2002 | 1999-2001 |
| Chukchi Sea | 37 | 105 | 3 | 1989 | 1995 | 1991-92 | 1997 | 1999 | 1997-99 | 1998 | 2004 | 2001-01 |
| Norton | 10 | 18 | 1 | 1991 | 1994 | 1991-93 | 1998 | 1998 | 1998 | 1999 | 2003 | 1999-2002 |
| Navarin | 82 | 229 | 7 | 1989 | 1994 | 1991-93 | 1998 | 2002 | 1999-2000 | 1998 | 2006 | 2001 |
| St. George | 11 | 35 | 1 | 1991 | 1994 | 1991-93 | 1998 | 1998 | 1998 | 1999 | 2003 | 1999-2002 |
| N. Aleutian | 12 | 39 | 1 | 1991 | 1996 | 1991-92 | 2000 | 2000 | 2000 | 2001 | 2005 | 2001-04 |
| Shumagin | 9 | 30 | 1 | 1992 | 1996 | 1992-93 | 1999 | 1999 | 1999 | 2000 | 2003 | 2000-02 |
| Gulf of Alaska | 12 | 42 | 1 | 1990 | 1994 | 1990-91 | 1998 | 1998 | 1998 | 1998 | 2002 | 1998-2001 |
| Cook Inlet | 10 | 23 | 1 | 1993 | 1997 | 1993 | 2000 | 2000 | 2000 | 2001 | 2003 | 2001-02 |
| Kodiak | 12 | 42 | 1 | 1993 | 1998 | 1993 | 2001 | 2001 | 2001 | 2002 | 2007 | 2002-06 |
| Hope | 13 | 40 | 1 | 1993 | 1997 | 1993-96 | 2001 | 2001 | 2001 | 2002 | 2006 | 2002-06 |

### (1) Introduction

The analysis of environmental impacts in all planning areas is significantly affected by the assumption made concerning how oil and gas production will be transported to shore and whether oil and gas will be tankered or pipelined to markets inside or outside of the planning area. The analysis of oil spills, which is presented in Section IV.A.4.a, incorporates detailed assumptions concerning both how oil and gas will be transported to shore and how oil and gas will be transported to markets. The column headed "Transportation Modes" provides the transportation scenarios for each planning area.

In analyzing the availability of transportation networks to deliver oil and gas to demand areas, both current and proposed networks were reviewed for all OCS planning areas. In addition, data submitted by State and local governments, Federal Agencies, industry, and the public in response to letters to the Governors of affected States and to the heads of relevant Federal Agencies, dated July 5, 1984, and a July 11, 1984, Federal Register Request for Comments Notice were also used. The results of this analysis have confirmed that the decision of whether to use pipelines, barges, or tankers to transport OCS oil and gas to shore is dependent on a number of factors, including technological constraints, environmental preferences, and economic considerations. The exact mode of transport cannot be determined until the amount of recoverable reserves is known and judgments are made as to what is environmentally preferable and technically and economically feasible.

The present analysis is limited to examination of issues related to transport of product among domestic market areas. There has been extensive public debate for and against sale and transport of Alaskan crude oil to Japan. Such sales currently are generally prohibited by Federal law. If authorized, OCS oil and gas resources could be delivered more cheaply to Japan than to many domestic market areas.

### (2) Transporting Oil and Gas Resources to Shore

At present, pipelines are generally used to bring oil and gas ashore in both the Gulf of Mexico and Southern California planning areas. The Gulf of Mexico is the only area with an extensive pipeline system, including a network of oil and gas gathering systems and trunk lines. In Southern California, the only other commercially producing OCS area, pipelines are desirable because, once installed, they generally do not adversely affect air quality commonly associated with tanker terminal use. The State of California also prefers pipelines due to its belief that there is a lower risk of oil spills. However, tankers are employed in the Gulf of Mexico and Southern California in a variety of situations to transport oil to refineries.

The specific transportation modes scenarios used have from 20 percent (central Gulf of Mexico) to 34 percent (southern California) of oil production being tankered to shore. These percentages of oil production tankered to shore reflect both early production prior to pipeline completion and possible production from fields which cannot use pipelines for economic, physical (water depth), and environmental reasons.

In areas where there is currently no production, such as the Atlantic OCS, an alternative transportation system may be required. Because of both the size and location of potential Atlantic OCS fields, it is expected that all Atlantic OCS crude would be transported via pipelines to common offshore loading points and then transported to shore by tankers. The same is likely to be true for any oil found where the resources may not economically justify pipelines, for example, in Central and Northern California and in the Eastern Gulf of Mexico. See the table in Section IV.A.4.a for specifics.

As there is not yet any oil and gas production on the Alaska OCS, transportation systems there are still speculative. However, three basic networks have been identified based on geography. The first involves oil and gas transportation from the Beaufort Sea, Chukchi Sea, and Hope Basin planning areas. Produced crude oil is expected to be transported through subsea and overland pipelines to the Trans-Alaskan Pipeline System (TAPS), where it would be routed to the Valdez tanker terminal.

Ice-breaking tankers are still being considered as a viable option to pipelines in many of the planning areas in Alaska including the western portion of the Chukchi Sea and Hope Basin. Tankering may be economically viable and may be the form of transportation selected by industry in Alaska as it was selected for example in the North Sea for marginal fields in their initial stage of production.

The second oil transportation scenario for Alaska encompasses possible production within the St. George Basin, Norton Sound, Navarin Basin, and the North Aleutian Basin planning areas. Transportation projections for these planning areas feature a series of gathering and trunk lines feeding into a central offshore or onshore terminal. Ice-breaking shuttle tankers would be used to move the crude to an ice-free deepwater port on the southern Alaskan peninsula for transshipment. As an alternative, it is possible that potential OCS production from the North Aleutian Basin would be piped directly to the transshipment terminal.

As another alternative, industry is currently indicating that ice-breaking tankers could be used to transport the product directly to market, without using any shuttle tankers, which minimizes the problems with potential spills associated with unloading and reloading. The vessels can use a variable pitch propeller system, which will give them power in the ice and speed in the open water.

The transportation of crude oil from OCS operations in the Bering Sea would require the construction of new tanker facilities. While weather conditions are severe in these areas, sea conditions would not preclude the use of conventional tankers during most of the year. The supply of tankers is not expected to pose a constraint on development of leases issued during the 1987-1991 time period.

The third scenario includes the Shumagin Basin, Kodiak, Cook Inlet, and Gulf of Alaska planning areas. If production from these OCS areas were to occur, it would likely be moved through subsea pipelines to storage facilities prior to being tankered directly to market. Some new tanker facilities would likely be required.

There is currently no system available to transport natural gas from the Prudhoe Bay area of the Alaska OCS to the contiguous United States. Based on current cost/price relationships and foreseeable technological advances, the gas resources estimated for the Beaufort Sea and Chukchi Sea planning areas are assumed in this analysis to be uneconomical. The Alaskan Natural Gas Transportation System (ANGTS) has been proposed to carry North Slope and Canadian natural gas to the lower 48 States. The pipeline is currently delivering gas from north of Calgary, Alberta, to Iowa and Oregon. However, the Alaskan and northern Canadian sections of the pipeline remain unbuilt. Sponsors of the ANGTS have announced delay in the target date for completion of the line, citing inability to obtain funding. Some analysts argue that the pipeline's estimated cost makes completion of the project economically impractical. Others contend that current economic conditions have only delayed its completion. If completed, the pipeline would carry North Slope and Canadian natural gas to markets as far as Chicago and San Francisco. Another pipeline, the All Alaska Natural Gas Pipeline, has been proposed to transport the North Slope gas to Kenai, Alaska, for processing and transportation.

In the absence of a pipeline, other gas transportation systems are being considered including liquefaction of natural gas (LNG) and conversion of gas to methanol. Industry indicates that the technology exists to use gathering lines to a grounded barge with prefabricated facilities for processing, storage, and utilities and to then tanker LNG to a terminal. The major problems lie in operating tankers in a hostile environment. Tankers designed with ice breaking capability and otherwise modified for operations in an arctic environment are believed to be feasible.

### (3) Transportation to Markets

It is assumed that all Atlantic OCS crude oil will be transported via tankers to refineries in the Mid-Atlantic planning area. Existing Atlantic coast refineries have a crude oil capacity of appropriately 1.4 million barrels per calendar day (bcd), and these refineries should have no problem refining peak production from the Atlantic OCS.

The existing refinery and continental pipelines system in the Gulf Coast imposes no constraint on processing and distribution of anticipated OCS production. It is assumed that all Gulf OCS production will be landed in the Gulf and processed and distributed in response to market conditions. For a variety of reasons, more detailed analysis is required for West Coast OCS production.

Specific assumptions are made to allocate OCS oil production between West and Gulf Coast refineries. Forecast Petroleum Administration for Defense District (PAD) V (Alaska, Hawaii, Washington, Oregon, California, Arizona, and Nevada) refining capacity is used as an upper bound on deliveries of OCS oil. Both onshore and OCS production from California, Oregon, and Washington are allocated to excess PAD V refineries. Alaska OCS oil and outer Alaskan oil are allocated to excess PAD V refinery capacity proportionately. The excess PAD V refinery capacity is calculated by subtracting the estimated production in California, Oregon, and Washington from the PAD V refining capacity. Most Alaskan and West Coast production not refined in PAD V is expected to be delivered to the Gulf Coast area for refining. An extensive pipeline system originating in the Gulf along with transport of refined products by barge and tanker will allow delivery to market centers throughout much of the country.

Explicit assumptions concerning future refining capacity and demand for petroleum in PAD V will provide a basis for estimating how much West Coast OCS oil will likely be refined and consumed on the West Coast for refining and use. The Department of Energy was consulted to obtain a forecast of future petroleum consumption in PAD V. Across all petroleum consuming sections the demand for refined products in PAD V is estimated to be approximately 2.75 million b/d in the year 2000 and 2.6 million b/d in the year 2010.

The PAD V consumption forecast must be augmented by a forecast of future export of refined products to have an estimate of total future PAD V refining capacity. In 1984, PAD V had net product export of 122.7 thousand b/d. Thus, net exports amount to approximately 4.5 percent of total refinery production. Increasing the forecast demand for petroleum production in the years 2000 and 2010 by 4.5 percent would increase the refinery production estimate to 2.87 million b/d in 2000 and 2.7 million b/d in 2010. The Department of Energy has not forecast expected future product exports from PAD V. Estimates of approximately 2.9 million b/d in 2000 and 2.7 million b/d in 2010 will be used in allocating Alaskan and West Coast OCS oil between PAD V refineries and refineries in the Gulf of Mexico.

The estimated total production in PAD V exceeds expected PAD V refining capacity past the year 2010. Transportation of part of the PAD V surplus by pipelines is expected. There are presently three proposed pipelines in various stages of the complex procedures for obtaining necessary permits. The proposed projects include the All-American Pipeline from Santa Barbara, California, to Midland, Texas, with a 300,000 b/d capacity; the Pacific-Texas pipeline from Long Beach, California, to Midland, Texas, with a proposed throughput of 900,000 b/d; and the expansion of the existing Four Corners pipelines to a proposed capacity of 150,000 b/d from Long Beach to New Mexico. For purposes of this analysis, it is assumed that pipeline transportation for PAD V oil will be operational by 1995. The capacity of pipeline transportation assumed in this analysis is 500,000 b/d.

In the past, concern has been expressed that the low gravity, high sulfur crude oil found on the California OCS and the low gravity oil from the Alaska North Slope could not be refined in most California refineries without violating California air quality standards. Retrofitting refineries to allow operations to meet air quality standards while processing lower quality crudes is expensive. Still, some California refineries are currently being modified to handle the lower quality crude oil expected to be produced in the near future.

### d. Summary of Impacts

Impact level definitions used in this summary and in the more detailed impact analysis in Section IV.B. are found in Appendix A.

#### (1) North Atlantic

In the physical environment category, water quality could be affected by oil spills and well discharges. Impacts on air quality would be caused by emissions from oil and gas installations.

All components of the physical enviroment category are expected to sustain a low level of impact.

In the biological environment category, intertidal and subtidal benthos, plankton, and fish resources could be affected by oil spills, well discharges, and placement of oil and gas structures (rigs, pipelines, platforms). Adverse impacts on marine mammals, seabirds, and endangered and threatened species could result from oil spills, noises from seismic surveying or vessel traffic, and encounters with vessel traffic. Estuaries and wetlands could be affected by oil spills and placement of oil and gas structures. Oil spills and placement of oil and gas structures, in addition to well discharges, would also affect areas of special concern. Marine sanctuaries would be impacted by oil spills and general OCS activities.

The following components of the biological environment category are expected to sustain a very low level of impact: nonendangered marine mammals, endangered and threatened species except the right whale, coastal and marine birds, and estuaries and wetlands. Low levels of impacts are expected for intertidal and subtidal benthos and plankton. Fish resources, areas of special concern, and potential marine sanctuaries are expected to sustain a moderate level of impact. The endangered right whale may experience a high impact if its prime feeding areas in the Great South Channel should be contaminated by an oil spill.

In the socioeconomic environmental category, employment and demographic conditions are affected by general OCS activities. Coastal land uses, marine vessel traffic and offshore infrastructure, and military uses are affected by placement of oil and gas structures. Oil spills and placement of oil and gas structures could cause an impact on commerical fisheries and archaeological resources. Adverse effects could be produced by oil spills, land use competition, and placement of oil and gas structures on recreational resources.

The following components of the socioeconomic environment category are expected to sustain a very low level of impact: regional employment and demographic conditions, commerical fisheries, recreational resources, military uses, and marine vessel traffic and offshore infrastructure. Employment and demographic conditions on a local level will sustain a very low to low level of impact. Low levels of impact are expected for archaeological resources. A moderate level of impact is expected for coastal land uses.

CUMULATIVE IMPACTS: A discussion of projects and proposals considered during the analysis of cumulative impacts can be found in Chapter IV.B. prior to the impact analysis for each planning area. In the physical environment category, cumulative impacts are expected to be low for offshore water quality. Onshore water and air are expected to sustain a moderate cumulative impact.

In the biological environment category, cumulative impacts on intertidal benthos, subtidal benthos, plankton and nonendangered mammals are expected to be low. Moderate cumulative impact levels are expected for coastal and marine birds, endangered and threatened species (expected the right whale), and areas of special concern. Potential marine sanctuaries, estuaries and wetlands, and right whales could sustain a high level of impact, and fish resources would expect a very high level of impact in the cumulative case.

In the socioeconomic environment category, cumulative impacts would be low for employment and demographic conditions and military uses. A moderate level of impact is expected for recreational resources and marine vessel traffic and offshore infrastructure. The impact level for archaeological resources could range from moderate to high. Commercial fisheries could sustain a high level of impact. Coastal land uses could expect impacts ranging form high to very high.

### (2) Mid-Atlantic

In the physical environment category, water quality could be affected by oil spills and well discharges. Impacts on air quality would be caused by emissions from oil and gas installations.

The offshore and onshore water quality components of the physical environment category are expected to sustain a low level of impact whereas impact to air quality would be very low.

In the biological environment category, intertidal and subtidal benthos, plankton, and fish resources could be affected by oil spills, well discharges, and placement of oil and gas structures (rigs, pipelines, platforms). Adverse impacts on marine mammals, seabirds, and endangered and threatened species could result from oil spills, noises from seismic surveying or vessel traffic, and encounters with vessel traffic. Estuaries and wetlands could be affected by oil spills and placement of oil and gas structures. Oil spills and placement of oil and gas structures, in addition to well discharges, would also affect areas of special concern. Marine sanctuaries would be impacted by oil spills and general OCS activities.

In the biological environment category, the following components are expected to sustain a very low level of impact: nonendangered marine mammals, coastal and marine birds, endangered and threatened species, estuaries and wetlands, areas of special concern, and marine sanctuaries. Potential physical disturbance of the U.S.S Monitor wreck is precluded by the six block subarea deferral which includes the U.S.S. Monitor National Marine Sanctuary and Buffer Zone. Low levels of impacts are expected for intertidal benthos, subtidal benthos, plankton, and fish resources.

In the socioeconomic environment category, employment and demographic conditions are affected by general OCS activities. Coastal land uses, marine vessel traffic and offshore infrastructure, and military uses are affected by placement of oil and gas structures. Oil spills and placement of oil and gas structures could cause an impact on commercial fisheries and archaeological resources. Adverse effects could be produced by oil spills, land use competition, and placement of oil and gas structures on recreational resources.

The following components of the socioeconomic category are expected to sustain a very low level of impact: employment and demographic conditions (on a regional level), recreational resources, and marine vessel traffic and offshore infrastructure.

Low levels of impact are expected for employment and demographic conditions (on a local level), commerical fisheries, archaeological resources. A moderate level of impact is expected for coastal land uses.

CUMULATIVE IMPACTS: In the physical environment category, onshore water and air quality would sustain a moderate level of impact. A high level of impact is expected for offshore water quality.

In the biological environment category, marine sanctuaries would sustain a very low level of impact. Impacts on plankton, intertidal benthos, subtidal benthos, and areas of special concern would be low. Non-endangered mammals, coastal and marine birds and endangered and threatened species (except the right whale) could sustain a moderate level of impact. Impacts on the endangered right whales and on estuaries and wetlands could be high. Fish resources could sustain a very high level of impact.

In the socioeconomic environment category, low levels of impact would be expected for employment and demographic conditions, marine vessel traffic and offshore infrastructure, and military uses. High levels of impacts are expected for commercial fisheries and archaeological resources. Coastal land uses and recreation and tourism resources could expect very high impacts.

### (3) South Atlantic

In the physical environment category, water quality could be affected by oil spills and well discharges. Impacts on air quality would be caused by emissions from oil and gas installations.

For the components of the physical environment category, the offshore and onshore water quality is expected to sustain a low level of impact, whereas impact to air quality would be very low.

In the biological environment category, intertidal and subtidal benthos, plankton, and fish resources could be affected by oil spills, well dischares, and placement of oil and gas structures (rigs, pipelines, platforms). Adverse impacts on marine mammals, coastal and marine birds, and endangered and threatened species could result from oil spills, noises from seismic surveying or vessel traffic, and encounters with vessel traffic. Estuaries and wetlands could be affected by oil spills and placement of oil and gas structures. Oil spills and placement of oil and gas structures, in addition to well discharges, could also affect areas of special concern. Marine sanctuaries could be impacted by oil spills and general OCS activities.

The following components of the biological environment category are expected to sustain a very low level of impact: estuaries and wetlands and areas of special concern. Low levels of impacts are expected for plankton, subtidal benthos, fish resources, nonendangered marine mammals, coastal and marine birds, endangered and threatened species (expect the right whale), and marine sanctuaries. Mechanical damage to Gray's Reef is precluded by the six block subarea deferral which includes the Gray's Reef National Marine Sanctuary. A moderate level of impact is expected for subtidal benthos. The endangered right whale may experience a very high level of impact due to disruption of its calving activities or harm to newborn calves resulting from a large oil spill.

In the socioeconomic environment category, employment and demographic conditions are affected by general OCS activities. Coastal land uses, marine vessel traffic and offshore infrastructure, and military uses are affected by placement of oil and gas structures. Oil spills and placement of oil and gas structures could cause an impact on commercial fisheries and archaeological resources. Adverse effects could be produced by oil spills, land use competition, and placement of oil and gas structures on recreational resources.

The following components of the socioeconomic environment category are expected to sustain a very low level of impact: employment and demographic conditions (on a regional level), recreational and tourism resources, marine vessel and offshore infrastructure, military uses and archaeological resources. Impacts on local employment and demographic conditions and commercial fisheries are expected to be low. A moderate level of impact is expected for coastal land uses.

CUMULATIVE IMPACTS: In the physical environment category, impacts on water quality (offshore and onshore) and air quality are expected to be moderate.

In the biological environment category, impacts are expected to be low for plankton, intertidal benthos, and nonendangered marine mammals. Moderate levels of impact would be sustained by subtidal benthos, fish resources, coastal and marine birds, estuaries and wetlands, areas of special concern, marine sanctuaries, and endangered and threatened marine mammals (except for the right whale). The endangered right whale may experience a very high impact.

In the socioeconomic category, military uses would sustain a very low level of impact. Marine vessel traffic and offshore infrastructure and commerical fisheries could expect a low level of impact. Impacts on archaeological resources would range from low to moderate. Moderate impact levels are expected for recreational and tourism resources. Employment and demographic conditions could expect to sustain a high level of impact, while coastal land uses would expect impacts to range from high to very high.

### (4) Western Gulf of Mexico

In the physical environment category, water quality could be affected by oil spills and well discharges. Impacts on air quality would be caused by emissions from oil and gas installations.

The following components of the physical environment category are expected to sustain a low level of impact: offshore and onshore water quality and air quality.

In the biological environment category, plankton, benthos, and fish resources could be affected by oil spills, well discharges, and placement of oil and gas structures (rigs, pipelines, platforms). Adverse impacts on marine mammals, coastal and marine birds, and endangered and threatened species could result from oil spills, noises from seismic surveying or vessel traffic, and encounters with vessel traffic. Seagrasses and wetlands could be affected by oil spills, placement of oil and gas pipelines, and dredging of navigational channels. Oil spills and placement of oil and gas structures, in addition to well discharges, could also affect areas of special concern.

Plankton is expected to sustain a very low level of impact. Low levels of impacts are expected for marine mammals, and seagrasses. Moderate levels of impacts are expected for fish resources, coastal and marine birds, endangered and threatened species, and wetlands. Very high levels of impacts could occur on benthic organisms on the topographic highs which are also areas of special concern, but benthos as a whole will sustain low impacts.

In the socioeconomic environment category, employment and demographic conditions are affected by general OCS activities. Coastal land uses, marine transportation and ports, and military uses are affected by placement of oil and gas structures. Oil spills and placement of oil and gas structures could cause an impact on water supply, commercial fisheries, and archaelogical resources. Adverse effects could be produced by oil spills, land use competition, and placement of oil and gas structures on recreation and tourism.

The following components of the socieconomic category are expected to sustain a very low level of impacts: employment and demographic conditions, coastal land uses, and marine transportation and ports. Low levels of impacts are expected for water supply and recreation and tourism, archaeological resources, and military uses.

Moderate levels of impacts are expected for commercial fisheries.

CUMULATIVE IMPACTS: In the physical environment category, air quality would sustain a moderate level of impact. A very high level of impact is expected for offshore and onshore water quality.

In the biological environment category, plankton would sustain a very low level of impact. Impacts on marine mammals would be low. Coastal and marine birds and seagrasses could sustain a moderate to high level of impact. Seagrasses could sustain a moderate level of impact. Impacts on fish resources, endangered and threatened species, and wetlands could expect a high level of impact. Benthos, areas of special concern, and marine sanctuaries could sustain a very high level of impact.

In the socioeconomic environment category, low levels of impact would be expected for employment and demographic conditions, coastal land uses and recreation and tourism. Low to moderate levels of impact would affect military uses. Air quality would sustain moderate impacts. High levels of impacts are expected for commercial fisheries, marine transportation and ports. Very high levels of impacts are expected for water supply and archaeological resources.

### (5) Central Gulf of Mexico

In the physical environment category, water quality could be affected by oil spills and well discharges. Impacts on air quality would be caused by emissions from oil and gas installations.

The following components of the physical environment category are expected to sustain a low level of impact: offshore and onshore water quality and air quality.

In the biological environment category, plankton, benthos, and fish resources could be affected by oil spills, well discharges, and placement of oil and gas structures (rigs, pipelines, platforms). Adverse impacts on marine mammals, coastal and marine birds, and endangered and threatened species could result from oil spills, noises from seismic surveying or vessel traffic, and encounters with vessel traffic. Seagrassses and wetlands could be affected by oil spills, placement of oil and gas pipelines and dredging of navigational channels. Oil spills and placement of oil and gas structures, in addition to well discharges, would also affect areas of special concern. There are no marine sanctuaries in the Central Gulf of Mexico.

In the biological environment category plankton is expected to sustain a very low level of impact. Low levels of impacts are expected for water quality, air quality, marine mammals, and benthos. Moderate levels of impacts are expected for fish resources, coastal and marine birds, endangered and threatened species, and seagrasses. High impacts on wetlands are expected. Very high levels of impacts are expected for benthic organisms on topographic highs and areas of special concern.

In the socioeconomic environment category, employment and demographic conditions are affected by general OCS activities. Coastal land uses, marine transportation and ports, and military uses are affected by placement of oil and gas structures. Oil spills and placement of oil and gas structures could cause an impact on water supply, commercial fisheries, and archaeological resources. Adverse effects could be produced by oil spills, land use competition, and placement of oil and gas structures on recreation and tourism.

The following components of the socioeconomic environment category are expected to sustain a very low level of impacts: employment and demographic conditions, coastal land uses, and coastal water supplies. Low levels of impacts are expected for recreation and tourism, marine transportation and ports, archaeological resources, and military uses. A moderate level of impact is expected for commercial fisheries.

CUMULATIVE IMPACTS: In the physical environment category, air quality would sustain a moderate level of impact. A very high level of impact is expected for offshore water quality.

In the biological environment category, plankton would sustain a very low level of impact. Impacts on marine mammals would be low. Fish resources, coastal and marine birds, seagrasses, and wetlands could sustain a high level of impact. Benthos, and areas of high concern could sustain a very high level of impact.

In the socioeconomic environment category, low levels of impact would be expected employment and demographic conditions, coastal land uses and recreation and tourism. High levels of impacts are expected for water supply, commercial fisheries, marine transportation and ports. Military uses would experience low to moderate impact levels. A very high level of impact is expected for archaeological resources.

### (6) Eastern Gulf of Mexico

In the physical environment category, water quality could be affected by oil spills and well discharges. Impacts on air quality would be caused by emissions from oil and gas installations.

The following components of the physical environment category are expected to sustain a low level of impact: offshore and onshore water quality and air quality.

In the biological environment category, plankton, benthos, and fish resources could be affected by oil spills, well discharges, and placement of oil and gas structures (rigs, pipelines, platforms). Adverse impacts on marine mammals, coastal and marine birds, and endangered and threatened species could result from oil spills, noises from seismic surveying or vessel traffic, and encounters with vessel traffic. Seagrasses and wetlands could be affected by oil spills, placement of oil and gas pipelines, and dredging of navigational channels. Oil spills and placement of oil and gas structures, in addition to well discharges, would also affect areas of special concern. There are no marine sanctuaries in the Eastern Gulf of Mexico.

In the biological environment category, plankton and benthos are expected to sustain a very low level of impact. Low levels of impacts are expected on marine mammals, coastal and marine birds, endangered and threatened species, seagrasses and wetlands, and fish resources. Very high levels of impacts are expected on benthos in live bottom areas and areas of special concern.

In the socioeconomic environment category, employment and demographic conditions are affected by general OCS activities. Coastal land uses, marine transportation and ports, and military uses are affected by placement of oil and gas structures. Oil spills and placement of oil and gas structures could cause an impact on commercial fisheries and archaeological resources. Adverse effects could be produced by oil spills, land use competition, and placement of oil and gas structures on recreational resources.

The following components of the socioeconomic environment category are expected to sustain a very low level of impacts: employment and demographic conditions, coastal land uses, recreation and tourism, and marine transporatation and ports. Low levels of impacts are expected for water supply and archeological resources, and military uses. A moderate level of impact is expected for commercial fisheries.

CUMULATIVE IMPACTS: In the physical environment category, air quality would sustain a moderate level of impact. A very high level of impact is expected for offshore and onshore water quality.

In the biological environment category, plankton would sustain a very low level of impact. Impacts on marine mammals and seagrasses would be low.

Endangered and threatened species and coastal and marine birds could sustain a moderate level of impact. Fish resources and wetlands could expect a high level of impact. Benthos and areas of special concern could sustain a very high level of impact.

In the socioeconomic environment category, recreation and tourism and transporatation and ports would have a very low level of impact. Low levels of impact would be expected for employment and demographic conditions, and coastal land uses. Military uses would experience a moderate level of impacts. High levels of impacts are expected for commercial fisheries. Very high levels of impact are expected for water supply and archaeological resources.

### (7) Washington/Oregon

The proposed development of oil and gas resources would cause moderate impacts to water quality in a localized area near a platform due to discharges of muds and cuttings, produced (formation) waters, and the release of some hydrocarbons, but regionally impacts on water quality would be low. Impacts on air quality would be low due to localized increases in air pollutants and slight increases in air emissions in the Puget Sound nonattainment area.

Subtidal benthic areas would be expected to sustain very high impacts in the immediate vicinity of a production platform, but regionally impacts on bentos would be very low.

Impacts to marine mammals would be very low, and impacts to marine birds would be low.

Endangered and threatened species would experience low impacts. The gray whale population is likely to be affected due to sources of noise associated with normal OCS development activities. An oil spill could cause low impacts to all species.

Estuaries can be expected to sustain a low level of impact from the proposal.

The proposed action would cause only a very slight increase in employment, personal income, and population, which would be a very low impact. Impacts on land use and water services would be very low. Impacts to commercial fisheries would be very low as a result of potential conflicts near platforms, subsea structures, and vessel traffic. Impacts to recreation, tourism, and cultural resources would be very low.

Marine vessel traffic, military uses, and native subsistence would experience very low impacts. Localized, moderate impacts to native subsistence could occur at any one location contacted by an oil spill.

CUMULATIVE IMPACTS: The overall cumulative impacts to water quality are expected to be moderate. Impacts on air quality would be low due to localized increases in air pollutants and slight increases in air emissions in a nonattainment area.

Benthic organisms would experience a low level of impacts while impacts to fishes would be very low.

The cumulative impacts for marine mammals and marine birds would be low. Impacts to endangered and threatened species would be low.

The cumulative effect of the proposed project combined with all other projects would result in a very slight increase in employment, personal income, and population. The impacts on a regional basis would be very low. Cumulative impacts on land use and water services would be very low. Commercial fisheries, recreation, and tourism would experience low impacts. Impacts on marine vessel traffic would be very low, while impacts on military use would be low. Impacts to native subsistence would be moderate.

### (8) Northern California

The proposed action would result in low impacts to water quality. Plankton exposed to discharge and sediment plumes would be temporarily affected and suffer very low levels of impact, and benthic communities are likely to change as a result of altered sediment or burial by muds and cuttings, suffering only very low overall impacts. Impacts to subtidal benthic organisms throughout the planning area would be very low while impacts to fish resources as a result of normal OCS activities would be low.

Overall impacts to marine mammals and marine birds are expected to be low. Endangered species overall would suffer a low level of impacts. Estuaries could experience low impacts, being most affected in the unlikely event of an oil spill.

The proposed project would cause only a very slight increase in employment, personal income, and population and a low impact. Impacts on land use would be very low, while water services would also experience very low impacts. Impacts on commercial fisheries would be low. Recreation, toruism, and cultural resources would experience very low impacts.

Marine vessel traffic, military uses, and native subsistence would experience very low impacts.

CUMULATIVE IMPACTS: The cumulative impacts on air and water quality would be low.

Subtidal and intertidal benthic communities would experience low impacts; for fish resources, and the impact level would be low. The cumulative impacts on marine mammals and marine birds would be low to moderate. Impacts to endangered and threatened species would be moderate.

The cumulative effect of the proposed project combined with all other projects would result in low impacts to employment and demographic conditions due to a slight increase in employment, personal income, and population causing low impacts. Moderate impacts on land use would occur, and impacts on water services would be very low. Commercial fisheries, recreation, and tourism would experience low impacts as would marine vessel traffic and military use. Impacts to native subsistence would be very low.

### (9) Central California

The proposed action would result in low impacts to water quality overall but to moderate impacts to water quality in small, localized areas adjacent to the platforms and pipeline routes. These impacts would be caused by discharges of muds and cuttings, produced waters, and sediment resuspension. Plankton exposed to discharge and sediment plumes would be temporarily affected, and benthic communities are likely to change as a result of altered sediment or burial by muds and cuttings. Impacts on air quality would be low. Increases in air emissions and air pollutant concentrations would be small and very localized.

Subtidal benthic areas could sustain very high impacts adjacent to a production platform but low impacts regionally. Impacts to plankton are expected to be very low, and low impacts to intertidal areas can be expected. Impacts to fish resources would be low regionally though localized impacts to certain species would be higher.

Overall impacts to marine mammals and marine birds are expected to be low. Locally high impacts could occur if nesting birds are disturbed.

Impacts to threatened and endangered species would be low regionally but locally moderate impacts can be expected. Low impacts to cetaceans could occur due to noise. Accidental events such as an oil spill or vessel collision are considered unlikely, but could result in locally moderate to high impacts to some species. The southern sea otter could experience regionally moderate impacts. Estuaries would experience low impacts.

The proposed project would cause only a very slight increase in employment, personal income, and population (a very low impact). Impacts on land use are expected to be low. Water services would experience very low impacts. Impacts on commercial fisheries as a whole would be very low although one individual fishery could sustain high impacts. Recreation, tourism, and cultural resources could experience very low impacts. Localized low impacts to recreational resources would occur as a result of offshore platforms and onshore pipelines in the immediate area.

Marine vessel traffic, military uses, and native subsistence would experience very low impacts. Localized, moderate impacts to native subsistence could occur but overall impacts are expected to be very low.

Deferral of the Point Reyes and Farallon Islands National Marine Sanctuary, the Point Reyes Wilderness area, San Francisco Bay, Monterey Bay, Cordell Bank, and the Big Sur subareas would reduce the impacts due to the proposal, by an indeterminable amount. Impacts to seabird nesting, breeding, foraging, and mitigating areas and pinniped rookeries would be avoided due to the elimination of exploration and development activities. Potential impacts to intertidal communities, subtidal benthos, and the California sea otter would be reduced due to the elimination of potential oil spills from within these areas. Visual impacts of offshore structures viewed from shore would also be avoided in the Big Sur and Monterey Bay areas since no offshore structures would be placed within sight of shore.

CUMULATIVE IMPACTS: Significant water quality degradation as a result of municipal wastewater and harbor activities occurs in areas in and near the San Francisco and Monterey Bays. Discharges associated with oil and gas development would degrade water quality in small areas adjacent to platforms and pipelines routes; localized impacts may be moderate. On a regional basis, cumulative impacts would be low to moderate. The cumulative impacts on air quality would be low.

Subtidal benthic communities would experience locally very high impacts but overall impacts would be low. Intertidal areas would have high local impacts and low regional impacts. Cumulative impacts to fish resources would be moderate.

The cumulative impacts on marine mammals and marine birds would be low regionally but locally moderate. The risk attributable to this proposal would be small compared with the cumulative risk as a result of an accidental spill due to tankering of foreign oil, vessel traffic, and continuing degradation and loss of important habitats.

Impacts to endangered and threatened species would be low regionally but moderate in localized areas. Cumulative impacts on estuaries and wetlands are expected to be moderate.

The cumulative effect of the proposed project combined with all other projects would result in very low impacts to employment and demographic conditions due to a slight increase in employment, personal income, and population. Some impacts could be higher in localized areas where future development may be concentrated. Cumulative impacts on land use and water services are expected to be low. Commercial fisheries and recreation and tourism would experience low impacts.

Impacts on marine vessel traffic and military use would be very low. Cumulative impacts to native subsistance would be moderate.

### (10) Southern California

The proposed action would result in low regional impacts to water quality but moderate impacts to water quality in small, localized areas adjacent to the platforms and pipeline routes. These impacts would be caused by discharges of muds and cuttings, produced waters, and sediment resuspension. Plankton exposed to discharge and sediment plumes would be temporarily affected, and benthic communities are likely to change as a result of altered sediment or burial by muds and cuttings. Impacts on air quality would be regionally low but moderate locally. Increases in air emissions and air pollutant concentrations would be small and very localized.

Subtidal benthic areas could sustain very high impacts adjacent to a production platform, but overall impacts would be very low. Impacts to fish resources as a result of OCS activities would be low.

Overall impacts to marine mammals are expected to be low except for possible moderate impacts to whales. Impacts on marine and coastal birds would be low. Accidental oil spills could result in high impacts to nesting species and moderate impacts to mitigating species.

Impacts to threatened and endangered species are expected to be moderate. Low impacts to cetaceans could occur due to noise and disturbances. Locally, high impacts to California brown pelicans and California clapper rails could occur. Estuaries and wetlands are expected to experience low impacts regionally.

The proposed project would cause a very slight increase in employment, personal income, and population (a low impact). Land use impacts are expected to be very low regionally but possibly very high on an extremely localized basis. Onshore oil and gas development may have a high impact on water resources for coastal communities and rural areas, depending upon the location of support facilities, but regionally the impact would be very low. Impacts on commercial fisheries would be low. Recreation, tourism, and cultural resources are expected to experience low impacts. Localized high impacts could occur to visual resources if any offshore platforms were placed close to shore.

Moderate impacts would occur to marine vessel traffic due to a small increase in the risk of collisions and potential conflicts. Impacts to military uses would be low, with locally moderate impacts possible due to the many critical and hazardous military operations conducted off Southern California. Native subsistence would receive very low impacts. However, localized moderate impacts could occur.

Deferral of the Channel Island National Marine Sanctuary subarea and the Santa Barbara Channel Ecological Preserve and Buffer Zone subarea would significantly reduce the risk of a potential oil spill affecting these subareas due to the greater amount of time it would take an oil spill to reach shore. Impacts to sensitive intertidal and subtidal benthic communities, pinnipeds, and seabirds from exploration and development activities would be avoided. Potential disruption of critical breeding and nesting activities from OCS activities would be reduced. Impacts to water quality in the Santa Barbara Channel Ecological Preserve would be reduced slightly. Additionally impacts to fish, commercial fish, and recreational resources would be reduced slightly. Deferral of the San Nicholas Navy Operating Area will significantly reduce military use conflicts.

CUMULATIVE IMPACTS: Significant water quality degradation as a result of municipal and industrial waste discharges, and other sources of contamination is affecting some areas in Southern California coastal waters. Discharges associated with oil and gas development would degrade water quality in small areas adjacent to platforms and pipelines routes; localized impacts may be moderate. On a regional basis, cumulative impacts would be low. The cumulative impacts on air quality would be moderate due to localized emissions in a nonattainment area.

Very high impacts to subtidal benthic communities would occur in the immediate vicinity of platforms, but regionally impacts would be low. Intertidal areas would have regionally low but locally moderate impacts. Cumulative impacts to fish resources would be low regionally and moderate locally.

The cumulative impacts on marine mammals and marine birds would be moderate. The risk attributable to this proposal would be small compared with the cumulative risk as a result of an accidental spill due to tankering of foreign oil, vessel traffic, and continuing degradation and loss of important habitats.

Impacts to endangered and threatened species would be moderate. Cumulative impacts on estuaries and wetlands would be low regionally, but localized areas could incur very high impacts.

The cumulative effect of the proposed project combined with all other projects would result in low impacts to employment and demographic conditions due to a slight increase in employment, personal income, and population. Some localized impact could be higher in localized areas where future development may be concentrated. Land use impacts would be low locally but could be very high in a localized area, depending upon existing land use patterns in and near the support facilities. Moderate impacts could occur to commercial fisheries. Cumulative impacts to recreational resources would be moderate regionally, but localized high impacts to visual resources are possible if any platforms are placed close to shore. Cumulative impacts to archaeological resources would be moderate.

Impacts to vessel traffic would be high due to the increased risk of vessel accidents and conflicts and oil spills. Military uses would experience moderate impacts. Overall, cumulative impacts to native subsistence would be low. However, localized, moderate impacts to native subsistence could occur.

### (11) Gulf of Alaska

In the physical environment category, water quality could be affected by oil spills and well discharges. Impacts on air quality would be caused by emissions from oil and gas installations. All components of the physical environment category are expected to sustain a low level of impact.

In the biological environment category, benthos, plankton, and fish resources could be affected by oil spills, well discharges, and placement of oil and gas structures (rigs, pipelines, platforms). Adverse impacts on marine mammals, coastal and marine birds, and endangered and threatened species could result from oil spills, noises from seismic surveying or vessel traffic, and encounters with vessel traffic.

Impacts on regional populations of plankton and benthos are expected to be low. Impacts on the local populations would be moderate. Impacts on fish resources are presented in four categories (salmonids, herring, groundfish and crabs). Impacts on regional populations of salmonids are expected to be low; impacts on local populations could be moderate. Impacts of this proposal on regional populations of herring are expected to be low; impacts on local populations could be moderate. Impacts on regional populations of groundfish are expected to be very low; for local populations, the impact would be moderate. Impacts on regional populations of crabs are expected to be low; impacts on local populations could be moderate. This proposal could impact marine mammals. This proposal could have moderate effects on sea otters, low impacts on pinnipeds species, and probably very low impacts on nonendangered cetaceans. Impacts of the proposal on regional populations of coastal and marine birds are expected to be moderate. The potential impacts on endangered whale species are expected to be low. Impacts on the endangered birds species are expected to very low in the Gulf of Alaska Planning Area. Impacts on estuaries and wetlands and areas of special concern are analyzed where they occur as habitat for the fish and wildlife species. There are no marine sanctuaries in Alaska.

In the socioeconomic environment category, employment and demographic conditions are affected by general OCS activities. Coastal land uses and marine vessel traffic are affected by placement of oil and gas structures. Oil spills and placement of oil and gas structures could cause an impact on commercial fisheries and archaeological resources. Adverse effects could be produced by oil spills, land use competition, and placement of oil and gas structures on recreational and tourist resources. Increased activity, higher population, and disturbance and/or destruction of biological resources could cause adverse effects to the sociocultural systems and subsistence use patterns in rural Alaska.

This proposal could impact the socioeconomic environment. The regional impacts to employment and population as a result of the proposal are low.

Impacts at the village level could be moderate. Regional impacts on coastal land uses would be low. Impacts on commercial fisheries from the proposed action are adjudged low. Impacts on recreation and tourism are expected to be low. Impacts on archaeological resources are expected to be low. On a regional basis, the impacts of the proposal on transportation could be considered low. The overall impact on subsistence in the planning area would be low. Impacts on sociocultural systems are expected to be low.

CUMULATIVE IMPACTS: In the physical environment, cumulative impacts are expected to be low for air and water quality.

The cumulative impacts on plankton and benthos would be low for regional populations and moderate for local populations.

The cumulative impacts on fish resources are discussed in four categories. Salmonid populations using areas the vicinity of Hinchinbrook Entrance, Yakutat Bay, and Controller Bay could experience moderate impacts. Impacts in other areas utilized by salmonids in Southeastern Alaska would be low. Herring populations using Prince William Sound could experience moderate impacts. Other important areas in Southeastern Alaska used for herring spawning are not expected to experience greater effects than low impacts. Halibut populations using areas in the vicinity of Hinchinbrook Entrance and Yakutat Bay could experience moderate impacts. Other areas used by groundfish in Southeastern Alaska are not expected to experience greater effects than the low impacts. Crab populations in the vicinity of Hinchinbrook Entrance or Yakutat Bay could experience moderate effects. Other areas in Southeastern Alaska used by crab are not expected to experience greater than low impacts. This proposal could have cumulative impacts on marine mammals. The proposal is likely to have no more than moderate impacts on sea otters and pinnipeds and low impacts on nonendangered cetaceans. Impacts on coastal and marine birds are expected to be high locally and moderate regionally. The potential for cumulative oil spill and noise-disturbance impacts on endangered cetaceans would no greater than moderate. Impacts on endangered and threatened birds would be very low. Impacts on estuaries and wetlands and areas of special concern are analyzed where they occur as habitat for the fish and wildlife species. There are no marine sanctuaries in Alaska.

This proposal could have cumulative impacts on the socioeconomic environment. Cumulative impacts on employment and population growth could be moderate both regionally and at the local level. Cumulative impacts on coastal land uses are expected to be low. The cumulative impacts on the regional commercial fishing industry are expected to remain low. The cumulative impacts on recreation and tourism are expected to be low. The cumulative impacts on archaelogical resources are expected to be low. The cumulative impacts on transportation are anticipated to be low. The cumulative impacts of oil spills and other industry activities could result in moderate impacts on subsistence in the planning area. Cumulative impacts on sociocultural systems are expected to be moderate.

(12) Kodiak

In the physical environment category, water quality could be affected by oil spills and well discharges. Impacts on air quality would be caused by emissions from oil and gas installations. All components of the physical environment category are expected to sustain a low level of impact.

In the biological environment category, benthos, plankton, and fish resources could be affected by oil spills, well discharges, and placement of oil and gas structures (rigs, pipelines, platforms). Adverse impacts on marine mammals, coastal and marine birds, and endangered and threatened species could result from oil spills, noises from seismic surveying or vessel traffic, and encounters with vessel traffic.

Impacts of the proposal on plankton and benthos are expected to be low on regional populations and moderate on local populations. The impacts on fish resources (salmonids, herring, groundfish, and crab) are low on regional population and moderate on local populations. Impacts on marine mammals are expected to be moderate on sea otters, low on pinnipeds, and very low on nonendangered cetaceans. Impacts on coastal and marine birds are expected to be moderate on regional populations and high on local populations. This proposal is expected to cause low impacts on whales and very low impacts on birds. Impacts on estuaries and wetlands and areas of special concern are analyzed where they occur as habitat for fish and wildlife species. There are no marine sanctuaries in Alaska.

In the socioeconomic environment category, employment and demographic conditions are affected by general OCS activities. Coastal land uses and marine vessel traffic are affected by placement of oil and gas structures. Oil spills and placement of oil and gas structures could cause an impact on commercial fisheries and archaeological resources. Adverse effects could be produced by oil spills, land use competitions, and placement of oil and gas structures on recreation and tourist resources. Increased activity, higher populations and disturbance, and/or destruction of biological resources could cause adverse effects to the sociocultural systems and subsistence use patterns in rural Alaska.

Impacts on employment and demographic conditions, commercial fisheries, recreation and tourism, archaeological resources, subsistence use patterns, and transportation system are expected to be low. Impacts on coastal land use would be moderate while they would be very low on sociocultural systems. There are no designated military areas offshore Alaska.

## CUMULATIVE IMPACTS

In the physical environment, cumulative impacts are expected to be low for air and water quality.

In the biological environment category, cumulative impacts are expected to be low on regional populations and moderate on local populations of plankton, benthos, and fish resources, moderate on sea otters and pinnipeds, low on nonendangered cetaceans, moderate for regional populations, high for local populations of coastal and marine birds, and low on endangered and threatened species of whales and birds.

In the socioeconomic environment, cumulative impacts are expected to be moderate on employment and demographic conditions and coastal land use; low on commerical fisheries, recreation and tourism, archaeological resources, subsistence use patterns, and transportation systems; and very low on sociocultural systems.

### (13) Cook Inlet

In the physical environment category, water quality could be affected by oil spills and well discharges. Impacts on air quality would be caused by emissions from oil and gas installations. All components of the physical environment category are expected to sustain a low level of impact.

In the biological environment category, benthos, plankton, fish resources could be affected by oil spills, well discharges, and placement of oil and gas structures (rigs, pipelines, platforms). Adverse impacts on marine mammals, coastal and marine birds, and endangered and threatened species could result from oil spills, noises from seismic surveying or vessel traffic, and encounters with vessel traffic.

In the biological environment category, plankton and benthos are expected to sustain a low impact. The impact on fish resources (salmonids and crab) would be moderate for local populations and low for regional populations. The impacts to marine mammals could be moderate on sea otters, low on pinnipeds, and very low on nonendangered cetaceans. Coastal and marine birds could expect a high impact locally and moderate impact regionally. Very low impact are expected on endangered and threatened species. Impacts on estuaries and wetlands and areas of special concern are analyzed where they occur as habitat for fish and wildlife species. There are no marine sanctuaries in Alaska.

In the socioeconomic environment category, employment and demographic conditions are affected by general OCS activities. Coastal land uses and marine vessel traffic are affected by placement of oil and gas structures. Oil spills and placement of oil and gas structures could cause an impact on commercial fisheries and archaeological resources. Adverse effects could be produced by oil spills, land use competition, and placement of oil and gas structures on recreation and tourist resources. Increased activity, higher populations and disturbance, and/or destruction of biological resources could cause adverse effects to the sociocultural systems and subsistence use patterns in rural Alaska.

Impacts to all eight categories of the socioeconomic environment are expected to be low.

## CUMULATIVE IMPACTS

In the physical environment, cumulative impacts are expected to be low for air and water quality.

In the biological environment category, cumulative impacts are expected to be very low for endangered and threatened species; low for plankton and

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benthos and nonendangered cetaceans; moderate for fish, crabs, pinnipeds, sea otters, and regional impacts on coastal and marine birds. Local populations of coastal and marine birds may experience high impacts.

In the socioeconomic environment, cumulative impacts are expected to be low for all categories, except recreation and tourism which would be moderate.

### (14) Shumagin

In the physical environment category, water quality could be affected by oil spills and well discharges. Impacts on air quality would be caused by emissions from oil and gas installations. Impacts on water quality and air quality are expected to be low.

In the biological environment category, benthos, plankton, fish resources could be affected by oil spills, well discharges, and placement of oil and gas structures (rigs, pipelines, platforms). Adverse impacts on marine mammals, coastal and marine birds, and endangered and threatened species could result from oil spills, noises from seismic surveying or vessel traffic, and encounters with vessel traffic.

Impacts on plankton and benthos could be moderate on local populations and low on regional populations. The impacts on fish resources (salmonids, herring, and crab) would be moderate on local populations and low on regional populations. The following impacts could be expected on marine mammals: sea otters, moderate; pinnipeds, low; and nonendangered cetaceans, very low. Coastal and marine birds could experience a high impact on local populations and moderate on regional populations. Impacts on endangered and threatened species are expected to be low for endangered whales, low for the Aleutian Canada goose, and very low for the shirt-tailed albatross. Impacts on estuaries and wetlands and areas of special concern are analyzed where they occur on habitat for fish and wildlife species. There are no marine sanctuaries in Alaska.

In the socioeconomic environment category, employment and demographic conditions are affected by general OCS activities. Coastal land uses and marine vessel traffic are affected by placement of oil and gas structures. Oil spills and placement of oil and gas structures could cause an impact on commercial fisheries and archaeological resources. Adverse effects could be produced by oil spills, land use competition, and placement of oil and gas structures on recreational and tourist resources. Increased activity, higher population and disturbance, and/or destruction of biological resources could cause adverse effects to the sociocultural systems and subsistence use patterns in rural Alaska.

Impacts on employment and demographic conditions are expected to be below regionally and moderate locally. Impacts on archaeological resources are expected to be low. Low impacts are expected on coastal land use, commercial fisheries, transportation systems, and subsistence use patterns. Impacts on recreation and tourism, as well as sociocultural systems, would be very low. There are no designated military areas offshore Alaska.

CUMULATIVE IMPACTS: In the physical environment, cumulative impacts are expected to be low for air and water quality.

In the biological category, cumulative impacts on plankton and benthos are expected to be moderate for local populations and low for regional populations. Impacts on fish resources (salmonids, herring, and crab) would be moderate on local population and low on regional populations. Cumulative impacts could be moderate on nonendangered cetaceans, fur seals, and sea otters. Regional population of coastal and marine birds could experience high impacts. Impacts to endangered and threatened species are expected to be moderate for endangered whales, low for the Aleutian Canada goose, and very low for short tailed albatross. Impacts on estuaries and wetlands and areas of special concern are analyzed where they occur as habitat for fish and wildlife species. There are no marine sanctuaries in Alaska.

In the socioeconomic environment, cumulative impacts are expected to be moderate for employment and demographic conditions, and subsistence use patterns; low for archaeological resources, coastal land use, commercial fisheries, recreation and tourism, and transportation systems; and very low for sociocultural systems. Local impacts on transportation systems would be high.

### (15) North Aleutian

In the physical environment category, water quality could be affected by oil spills and well discharges. Impacts on air quality would be caused by emissions from oil and gas installations.

All components of the physical environment category are expected to sustain a low level of impact.

In the biological environment category, benthos, plankton, and fish resources could be affected by oil spills, well discharges, and placement of oil and gas structures (rigs, pipelines, platforms). Adverse impacts on marine mammals, coastal and marine birds, and endangered and threatened species could result from oil spills, noises from seismic surveying or vessel traffic, and encounters with vessel traffic.

Impacts of the proposal on regional populations of planktonic invertebrates are expected to be very low and local impacts low on plankton and benthos. Impacts on populations of salmon and groundfish are expected to be low. Local impacts could be moderate. Impacts of the proposal on regional populations of herring and other forage fish are expected to be low. Local impacts could be high. Overall impacts of this proposal on regional populations of red king crab could be high. In the North Aleutian Basin Planning Area, there could be moderate impacts on sea otters, low impacts on pinniped species, and very low impacts on nonendangered cetaceans. Throughout most of the planning area, adverse impacts on regional populations of coastal and marine birds are expected to be moderate. Impacts on local populations may be high. Impacts to the blue, sei, sperm, and bowhead whales and the endangered birds could be very low. Impacts from the proposal to gray, fin, right, and humpback whales could be low.

In the socioeconomic environment category, employment and demographic conditions are affected by general OCS activities. Coastal land uses and marine vessel traffic are affected by placement of oil and gas structures. Oil spills and placement of oil and gas structures could cause an impact on commercial fisheries and archaeological resources. Adverse effects could be produced by oil spills, land use competition, and placement of oil and gas structures on recreational and tourist resources. Increased activity, higher population, and disturbance and/or destruction of biological resources could cause adverse effects to the sociocultural systems and subsistence use patterns in rural Alaska.

The component of the socioeconomic environment category is expected to sustain a very low level of impact on employment and demographic conditions in Cold Bay and Unalaska and low impact on Sand Point. Moderate levels of impacts are expected for coastal land uses, and low levels for subsistence use patterns and sociocultural systems. Low levels of impacts are expected for recreation and tourism and for archaeological resources. Transportation systems are expected to sustain a high level of impact on a local level while commercial fisheries will sustain a low to high (crab) level of impact.

CUMULATIVE IMPACTS: In the physical environment, cumulative impacts are expected to be low for air and water quality.

In the cumulative case, plankton are expected to experience a low impacts. Impacts on regional populations of salmon and groundfish are expected to be low. Local impacts could be moderate. Impacts on forage fish could be moderate regionally and high for local populations. Impacts on red king crab could be high. Impacts would be moderate on nonendangered cetaceans, fur seals, and sea otters, and low on other species. Cumulative impacts on regional populations of coastal and marine birds could be moderate within the North Aleutian Basin. Local populations may experience high impacts. Impacts to endangered whales are expected to be low except to gray whales where impacts are expected to be moderate.

Cumulative employment and subsequent population growth will be moderate both regionally and at the local level. The cumulative impact of development activities on land uses would be high. Overall cumulative impacts on the southeastern Bering Sea fisheries are likely to be low for the commercial salmon, herring, and groundfish fisheries. A high impact is anticipated for the commercial red king crab fishery. Cumulative impacts on recreation and tourism are expected to be low. The cumulative impacts on archaeological resources are expected to be low. The cumulative impact on transportation systems could be high. The impacts on subsistence could be low. Impacts on sociocultural systems could be moderate.

### (16) St. George

In the physical enviroment category, water quality could be affected by oil spills and well discharges. Impacts on air quality would be caused by emissions from oil and gas installations.

All components of the physical environment category are expected to sustain a low level of impact.

In the biological environment category, benthos, plankton, and fish resources could be affected by oil spills, well discharges, and placement of oil and gas structures (rigs, pipelines, platforms). Adverse impacts on marine mammals, coastal and marine birds, and endangered and threatened species could result from oils spills, noises from seismic surveying or vessel traffic, and encounters with vessel traffic.

The following components of the biological environment category are expected to sustain a very low level of impact: plankton, benthics, and fish resources.

The proposal could have moderate impacts on fur seals and sea otters and low impacts on other nonendangered marine mammals. Impacts on regional populations of coastal and marine birds are expected to be low. Impacts on local populations could be high. Impacts are expected to be very low for endangered birds and blue, sei, sperm, and bowhead whales. Impacts to the fin, gray, right, and humpback whales are expected to be low.

In the socioeconomic environment category, employment and demographic conditions are affected by general OCS activities. Coastal land uses and marine vessel traffic are affected by placement of oil and gas structures. Oil spills and placement of oil and gas structures could cause an impact on commercial fisheries and archaeological resources. Adverse effects could be produced by oil spills, land use competition, and placement of oil and gas structures on recreational and tourist resources. Increased activity, higher population, and disturbance and/or destruction of biological resources could cause adverse effects to the sociocultural systems and subsistence use patterns in rural Alaska.

Impacts on employment and demographic conditions are expected to be moderate. The impact on Unalaska and Cold Bay as a result of facility and residential land-use demands would be low. Siting of a service base, marine terminal, and pipeline land fall could have moderate impacts on land uses on St. Paul. Overall impacts of the proposal on the commercial fishing industry are expected to be very low. Impacts on recreation and tourism are expected to be very low. Impacts on archaeological resources are expected to be low. Impacts on transportation systems are expected to be moderate. Impacts on sociocultural systems are expected to be moderate on Pribilof Islands and very low for Cold Bay and Unalaska. Based on the type of subsistence harvest and the population's subsistence-use characteristics, the impact could be high in the Pribilof Islands and low in the remainder of the region.

CUMULATIVE IMPACTS: In the physical environment, cumulative impacts are expected to be low for air and water quality.

In the biological environment category cumulative impacts on plankton, benthos, and fish resources would be very low; moderate on fur seals and sea otters and low on other nonendangered marine mammals. Cumulative impacts on regional populations of coastal and marine birds could be moderate; impacts to local populations could be high. Impacts to endangered whales are expected to be low and very low for endangered birds.

In the socioeconomic environment, cumulative impacts are expected to be moderate for transportation systems, employment and demography, coastal land use, and low for archaeological resources. Commercial fisheries are expected to sustain very low impacts; recreation and tourism, very low impacts; subsistence systems low impacts (except high for the Pribilofs) and sociocultural systems very low for Cold Bay and Unalaska to moderate impacts for the Pribilof Islands.

(17) Navarin

In the physical environment category, water quality could be affected by oil spills and well discharges. Impacts on air quality would be caused by emissions from oil and gas installations.

In the physcial environment category, water quality is expected to sustain a low level of impact and air quality a very low level of impact.

In the biological environment category, benthos, plankton, and fish resources could be affected by oil spills, well discharges, and placement of oil and gas structures (rigs, pipelines, platforms). Adverse impacts on marine mammals, coastal and marine birds, and endangered and threatened species could result from oil spills, noises from seismic surveying or vessel traffic, and encounters with vessel traffic.

Overall, impacts of this proposal on regional populations of planktonic invertebrates are expected to be very low. The impact on fish resources would be low. The impacts on nonendangered marine mammals are likely to be low. Impacts on coastal and marine birds are likely to be low. Impacts of the proposal on gray, fin, sperm, right, and humpback whales are expected to be low. Impacts on bowheads are expected to be moderate. Impacts on the short-tailed albatross are expected to be very low.

In the socioeconomic environment category, employment and demographic conditions are affected by general OCS activities. Coastal land uses and marine vessel traffic are affected by placement of oil and gas structures. Oil spills and placement of oil and gas structures could cause an impact on commercial fisheries and cultural resources. Adverse effects could be produced by oil spills, land use competition, and placement of oil and gas structures on recreational and tourist resources. Increased activity, higher population, and disturbance and/or destruction of biological resources could cause adverse effects to the sociocultural systems and subsistence use patterns in rural Alaska.

The commercial fishing, recreation/tourism and archaeological resource components of the socioeconomic environment category is expected to sustain a very low level of impact. Low levels of impacts are expected for coastal land uses, and sociocultural systems. Moderate levels of impacts are expected for employment and demographic conditions and transportation systems. Subsistence use patterns are expected to sustain a low level of impact.

CUMULATIVE IMPACTS: In the physical environment, cumulative impacts are expected to be low for water quality and very low for air quality.

In the cumulative case, plankton are not expected to experience greater than very low effects from the proposal. Impacts on the groundfish, shellfish, salmonids, and herring would be low. Cumulative impacts are likely to have moderate impacts on marine mammals. Cumulative impacts on regional coastal and marine bird populations could be low in the vicinity of the planning area; however, high effects could occur in the Pribilof Islands and Unimak Pass. Impacts to bowheads are expected to be moderate and not to exceed moderate for gray, fin, sperm, or humpback whales. Cumulative impacts to the short-tailed albatross would be very low.

Cumulative impacts could be moderate for employment and demographic conditions, subsistence use systems, sociocultural systems, and transportation systems. Low impacts could be expected for coastal land use and commercial fisheries, and very low for recreation and tourism and archaeological resources.

### (18) Norton

In the physical environment category, water quality could be affected by oil spills and well discharges. Impacts on air quality would be caused by emissions from oil and gas installations. All components of the physical environment category are expected to sustain a low level of impact.

In the biological environment category, benthos, plankton, and fish resources could be affected by oil spills, well discharges, and placement of oil and gas structures (rigs, pipelines, platforms). Adverse impacts on marine mammals, coastal and marine birds, and endangered and threatened species could result from oil spills, noises from seismic surverying or vessel traffic, and encounters with vessel traffic.

In the biological environment category, impacts are expected to be low for plankton and benthos, marine mammals, and endangered and threatened species. Impacts to fish resources are expected to be moderate to local population and low for regional populations. Impacts to coastal and marine birds would be moderate.

In the socioeconomic environment category, employment and demographic conditions are affected by general OCS activities. Coastal land uses and marine vessel traffic are affected by placement of oil and gas stuctures. Oil spills and placement of oil and gas structures could cause an impact on commercial fisheries and archaeological resources. Adverse effects could be produced by oil spills, land use competition, and placement of oil and gas structures on recreational and tourist resources. Increased activity, higher population, and disturbance and/or destruction of biological resources could cause adverse effects to the sociocultural systems and subsistence use patterns in rural Alaska.

The following components of the socioeconomic environment category are expected to sustain a low level of impact: coastal land use, commercial fishing, recreation and tourism, archaeological resources, sociocultural systems, and transportation systems. Employment and demographic conditions are expected to experience moderate impacts. Impacts to subsistence use patterns are expected to be moderate in the Nome/Cape Nome and St. Lawrence Island regions and low in the remainder of the area.

CUMULATIVE IMPACTS: In the physical environment, cumulative impacts are expected to be low for water quality and moderate for air quality.

In the biological environment category, cumulative impacts on all resources analyzed are expected to be moderate.

In the socioeconomic environment, cumulative impacts are expected to be moderate for employment and demographic conditions, commercial fishing, and subsistence use patterns. Low impacts are expected to coastal land use, recreation and tourism, archaeological resources, and transportation systems. Sociocultural systems are expected to experience high impacts.

### (19) Hope

In the physical environment category, water quality could be affected by oil spills and well discharges. Impacts on air quality would be caused by emissions from oil and gas installations.

All components of the physical environment category are expected to sustain a low level of impact.

In the biological environment category, benthos, plankton, and fish resources could be affected by oil spills, well discharges, and placement of oil and gas structures (rigs, pipelines, platforms). Adverse impacts on marine mammals, coastal and marine birds, and endangered and threatened species could result from oil spills, noises from seismic surveying or vessel traffic, and encounters with vessel traffic.

All components of the biological environment category are expected to sustain a low level of impact.

In the socioeconomic category, employment and demographic conditions are affected by general OCS activities. Coastal land uses and marine vessel traffic are affected by placement of oil and gas structures. Oil spills and placement of oil and gas structures could cause an impact on commercial fisheries and cultural resources. Adverse effects could be produced by oil spills, land use competition, and placement of oil and gas structures on recreational and tourist resources. Increased activity, higher population, and disturbance and/or destruction of biological resources could cause adverse effects to the sociocultural systems and subsistence use patterns in rural Alaska.

The following components of the socioeconomic environment category are expected to sustain a very low level of impact: commercial fisheries, recreation and tourism, and sociocultural systems. Low impacts are expected for employment and demographic conditions archaeological resources and subsistence use patterns. Moderate levels of impacts are expected for transportation systems. Coastal land uses are expected to sustain a moderate level of impact.

CUMULATIVE IMPACTS: In the physical environment, cumulative impacts are expected to be low for air and water quality.

Cumulative impacts on planktonic and benthic organisms and fish resources are generally expected to be low. Cumulative oil and gas activities in the Hope Basin and possible ore-carrier traffic from the onshore mining project probably would have a combined moderate impact on nonendangered marine mammal populations. Cumulative activities could have moderate impacts on coastal and marine birds. Impacts on endangered species due to long-term impacts from oil and gas activities are not expected to exceed low.

In the socioeconomic environment, cumulative impacts are expected to be low on employment and demographic conditions, commercial fisheries, recreation and tourism, subsistence use patterns, archaeological resources, and sociocultural systems. Moderate impacts may be expected for transportation systems, and on coastal land use.

### (20) Chukchi

In the physical environment category, water quality could be affected by oil spills and well discharges. Impacts on air quality would be caused by emissions from oil and gas installations.

All components of the physical environment category are expected to sustain a low level of impact.

In the biological environment category, benthos, plankton, and fish resources could be affected by oil spills, well discharges, and placement of oil and gas structures (rigs, pipelines, platforms). Adverse impacts on marine mammals, coastal and marine birds, and endangered and threatened species could result from oil spills, noises from seismic surveying or vessel traffic, and encounters with vessel traffic.

The following components of the biological environment category are expected to sustain a low level of impact: plankton, benthos, fish resources, marine mammals, caribou and endangered and threatened species. Moderate impacts are expected for coastal and marine birds.

In the socioeconomic environment category, employment and demographic conditions are affected by general OCS activities. Coastal land uses and marine vessel traffic are affected by placement of oil and gas structures. Oil spills and placement of oil and gas structures could cause an impact on commercial fisheries and cultural resources. Adverse effects could be produced by oil spills, land use competition, and placement of oil and gas structures on recreational and tourist resources. Increased activity, higher population, and disturbance and/or destruction of biological resources could cause adverse effects to the sociocultural systems and subsistence use patterns in rural Alaska.

Components of the socioeconomic environment category expected to sustain low levels of impact are employment and demographic conditions and recreation and tourism. Moderate impacts are expected for coastal land use, subsistence use patterns, and sociocultural systems. High impacts are expected on transportation systems. Archaeological reources may sustain a very low level of impact.

Cumulative Impacts: In the physical environment, cumulative impacts are expected to be low for air and water quality.

In the biological environment category cumulative impacts are expected to be low on plankton and benthos and moderate on fisheries resources. Cumulative impacts on marine mammals and caribou would be moderate. High impacts to coastal and marine birds populations could occur. Long-term impacts on endangered whales are expected to be moderate and low on the peregrine falcon.

Cumulative impacts on employment and demographic conditions could be low. The long-term impacts of lengthy linear development along the Arctic coast and foothills of the Brooks Range could be high on coastal land use. Cumulative impacts on recreation and tourism would be low. Cumulative impacts of the proposal on transportation systems could be high. Cumulative impacts of activities could result in moderate impacts on subsistence use patterns and sociocultural systems in the planning area. Impacts on archaeological resources would be very low.

### (21) Beaufort

In the physical environment category, water quality could be affected by oil spills and well discharges. Impacts on air quality would be caused by emissions from oil and gas installations.

All components of the physical environment category are expected to sustain a low level of impact.

In the biological environment category, benthos, plankton, and fish resources could be affected by oil spills, well discharges, and placement of oil and gas structures (rigs, pipelines, platforms). Adverse impacts on marine mammals, coastal and marine birds, and endangered and threatened species could result from oil spills, noises from seismic surveying or vessel traffic, and encounters with vessel traffic.

Implementation of the proposal would result in low impacts on planktonic and benthic organisms on regional populations and moderate on local populations. Impacts on fish resources are expected to be low regionally and moderate locally. The effects from activities associated with the proposal on ringed seals, polar bears, caribou and pinnipeds would be low and would be very low on beluga whales. The impacts on coastal and marine bird populations are likely to be moderate. Impacts are not expected to exceed moderate for bowhead whales and low for gray whales and the pereqrine falcon.

In the socioeconomic environment category, employment and demographic conditions are affected by general OCS activities. Coastal land uses and marine vessel traffic are affected by placement of oil and gas structures. Oil spills and placement of oil and gas structures could cause an impact on commercial fisheries and archaeological resources. Adverse effects could be produced by oil spills, land use competition, and placement of oil and gas structures on recreational and tourist resources. Increased activity, higher population, and disturbance and/or destruction of biological resources could cause adverse effects to the sociocultural systems and subsistence use patterns in rural Alaska.

The following components of the socioeconomic environment category are expected to sustain a low level of impact: employment and demographic conditions, commercial fisheries, coastal land uses, archaeological resources and sociocultural systems. Very low levels of impacts are expected for recreation and tourism; moderate levels for subsistence use patterns, and transportation systems.

CUMULATIVE IMPACTS: In the physical environment, cumulative impacts are expected to be low for air and water quality.

Cumulative impacts to planktonic and benthic organisms are expected to be moderate. Cumulative effects to fish resources are expected to be moderate. The proposal would have low impacts on nonendangered marine mammals occurring in the Beaufort Sea. Cumulative impacts on coastal and marine birds and caribou could be high. Impacts to bowhead whales are expected to be moderate and gray whales and pereqrine falcons would be expected to experience low impacts.

Impacts on employment and demographic conditions would be moderate and on coastal land uses would be high. Cumulative impacts on commercial fisheries, archaeological resources, and on recreation and tourism are assessed to be low. Impacts on transportation systems, subsistence use patterns, and sociocultural systems are expected to be moderate.

## 2. Alternative II - Subarea Deferrals

### a. Description of the Alternative

This alternative evaluates the deferral from leasing in this 5-year program of 13 subareas within the OCS planning areas (see Figures II.A.2.a-1 through II.A.2.a-10). Requests for deferrals of about 100 specific geographic subareas or categories of subareas have been received in response to the July 1984 and March 1985 Federal Register Notices regarding the new 5-year program. These subareas, in addition to a number of Department of Defense and National Aeronautics and Space Administration use areas, were described, and the potential impacts which would be avoided, should they be deferred from leasing, were evaluated in Attachment 5 to the SID for the Proposed Program. In his decision on the Proposed Program, the Secretary proposes to defer from leasing 15 subareas, 14 of which are deferred from the proposed action (Alternative I), and one, the Atlantic portion of the Straits of Florida, is deferred from consideration under Alternative III. The analysis of potential impacts avoided by deferral of the 14 subareas is included in Alternative I of this EIS. The Secretary also identified an additional 13 subareas for further analysis and comment regarding their deferral. This alternative provides a discussion of the potential impacts avoided, should the Secretary choose to defer from leasing any or all of the following 13 subareas:

The NASA Flight Clearance Zone Offshore Cape Canaveral, Florida - This area consists of approximately 3,580 blocks extending about 170 nautical miles offshore in the South Atlantic planning area. (Figure II.A.2.a-1).

North Atlantic Nearshore Block Deferral - This subarea extends 15 miles from shore along the Atlantic coast in the North Atlantic planning areas. (Figure II.A.2.a-2).

Mid-Atlantic Nearshore Block Deferral - This subarea extends 15 miles from shore along the coast in the the Mid-Atlantic planning area. (Figure II.A.2.a-2).

South Atlantic Nearshore Block Deferral - This subarea extends 15 miles from shore along the coast of the South Atlantic planning area. (Figure II.A.2.a-2).

The Florida West Coast Nearshore Block Deferral - This subarea extends 30 miles from shore along the west coast of Florida (Eastern Gulf of Mexico) from Naples to Apalachicola except in the Gainesville map area. (Figure II.A.2.a-3).

Eastern Gulf of Mexico, Miami Map Area - This subarea area consists of about 1 million acres in the Miami map (protraction diagram) area. (Figure II.A.2.a-3).

Subarea off Unimak Pass - St. George - This subarea consists of about 210 blocks in the Bering Sea, north of Unimak Pass. (Figure II.A.2.a-4).

Subarea off Unimak Pass - North Aleutian - This subarea consists of approximately 48 blocks in the Bering Sea, northeast of Unimak Pass. (Figure II.A.2.a-4).

Subarea off Point Barrow - This subarea consists of approximately 59 blocks in the Beaufort Sea planning area, north of Point Barrow. (Figure II.A.2.a-5).

Gulf of Maine - This subarea consists of about 1,846 blocks in the North Atlantic planning area. (Figure II.A.2.a-6).

Area beyond the area of hydrocarbon potential, offshore Washington and Oregon - This subarea consists of seaward portions of Washington and Oregon. (Figures II.A.2.a.7 and II.A.2.a-8).

Area beyond the area of hydrocarbon potential offshore Northern California - This subarea consists of seaward portions of the planning area. (Figure II.A.2.a-9).

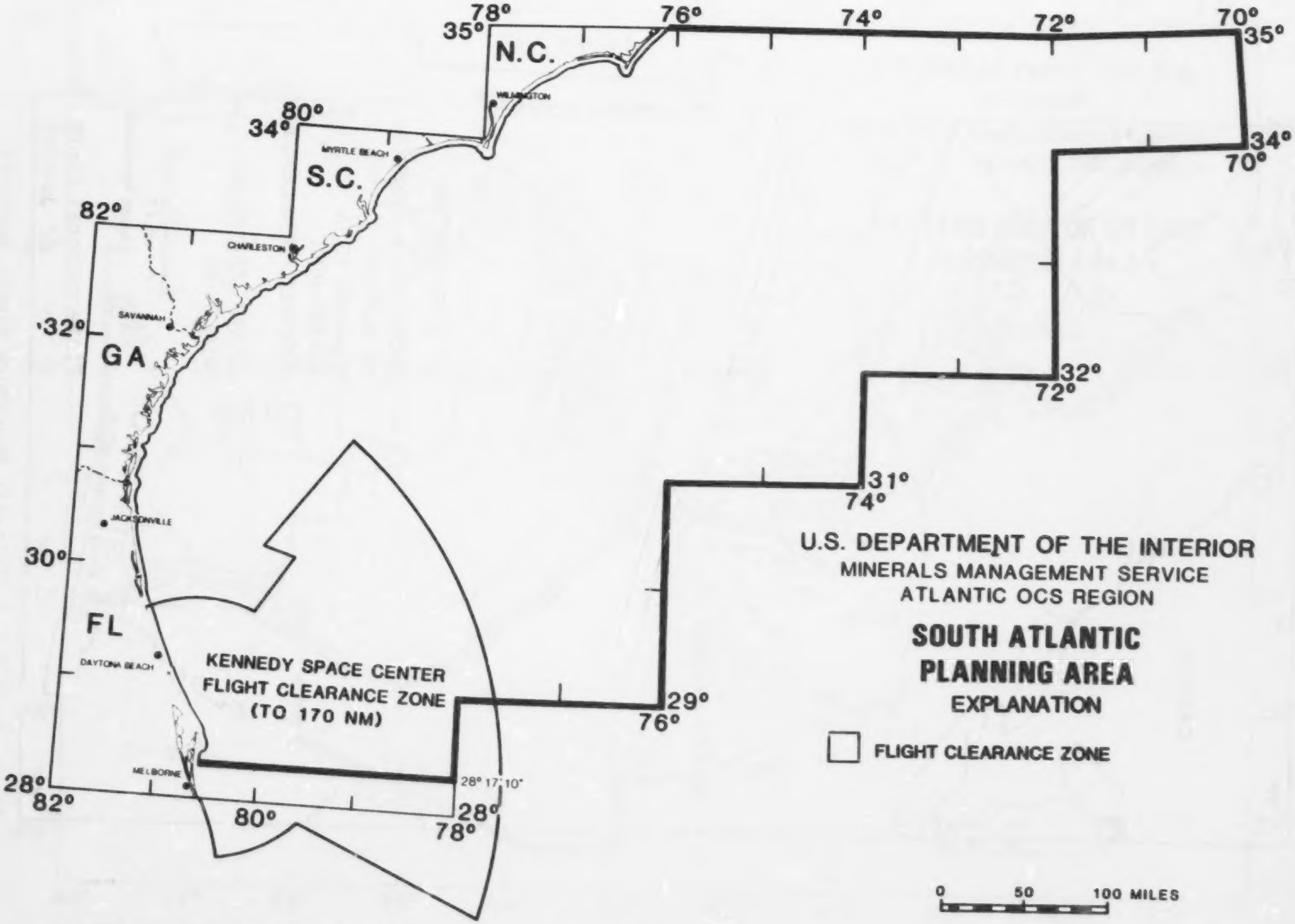


Figure II.A.2.a-1. NASA Flight Clearance Zone Subarea.

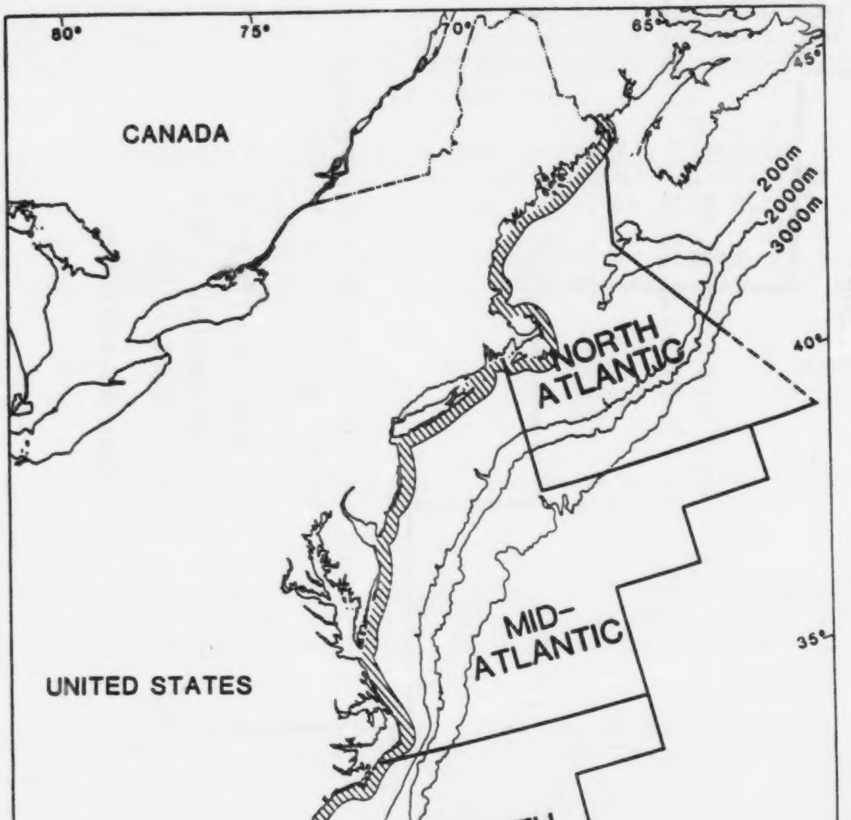


Figure II.A.2.a-2. Atlantic Nearshore Blocks Subareas.

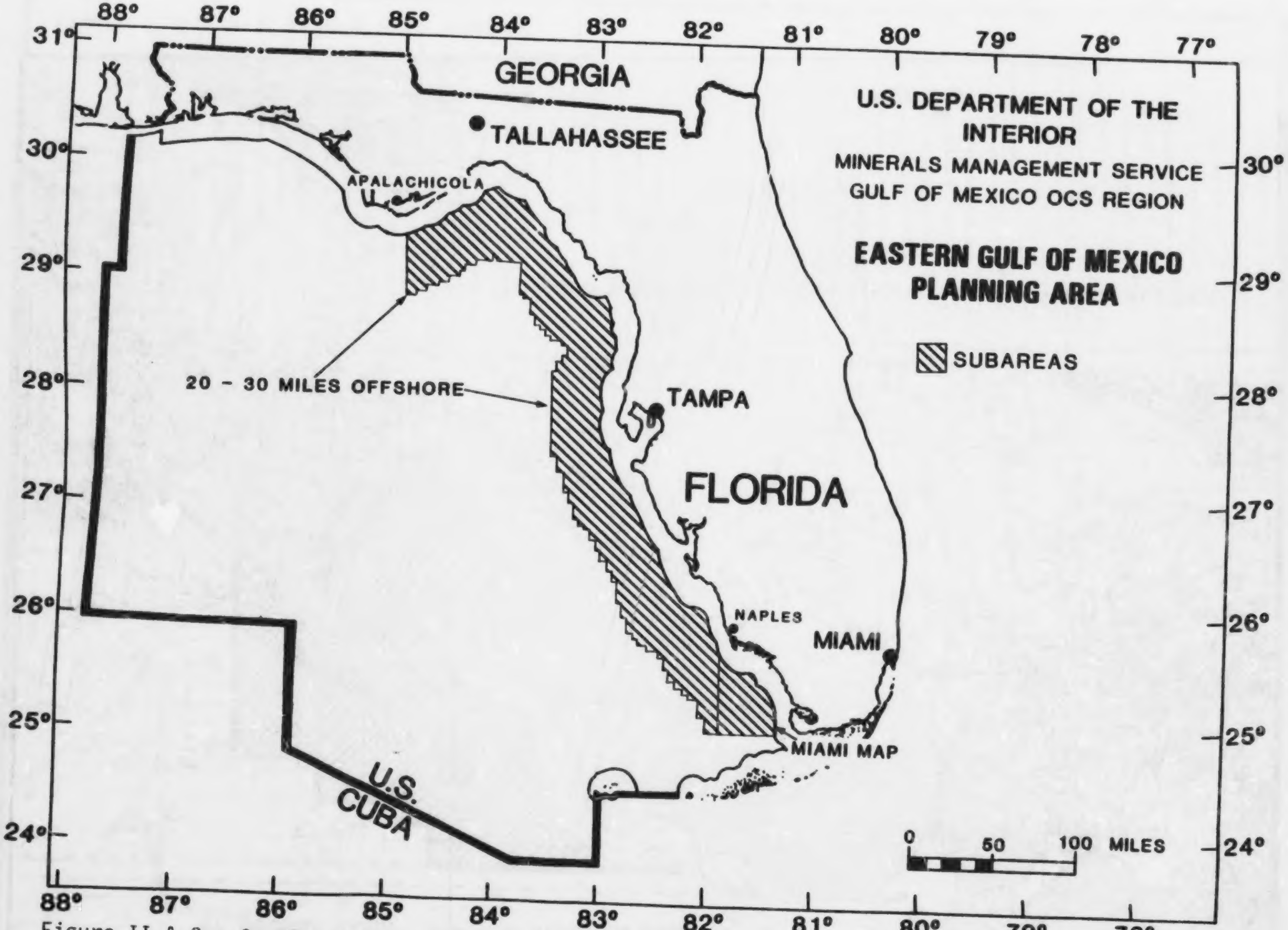


Figure II.A.2.a-3. Florida West Coast Nearshore Blocks Subarea.

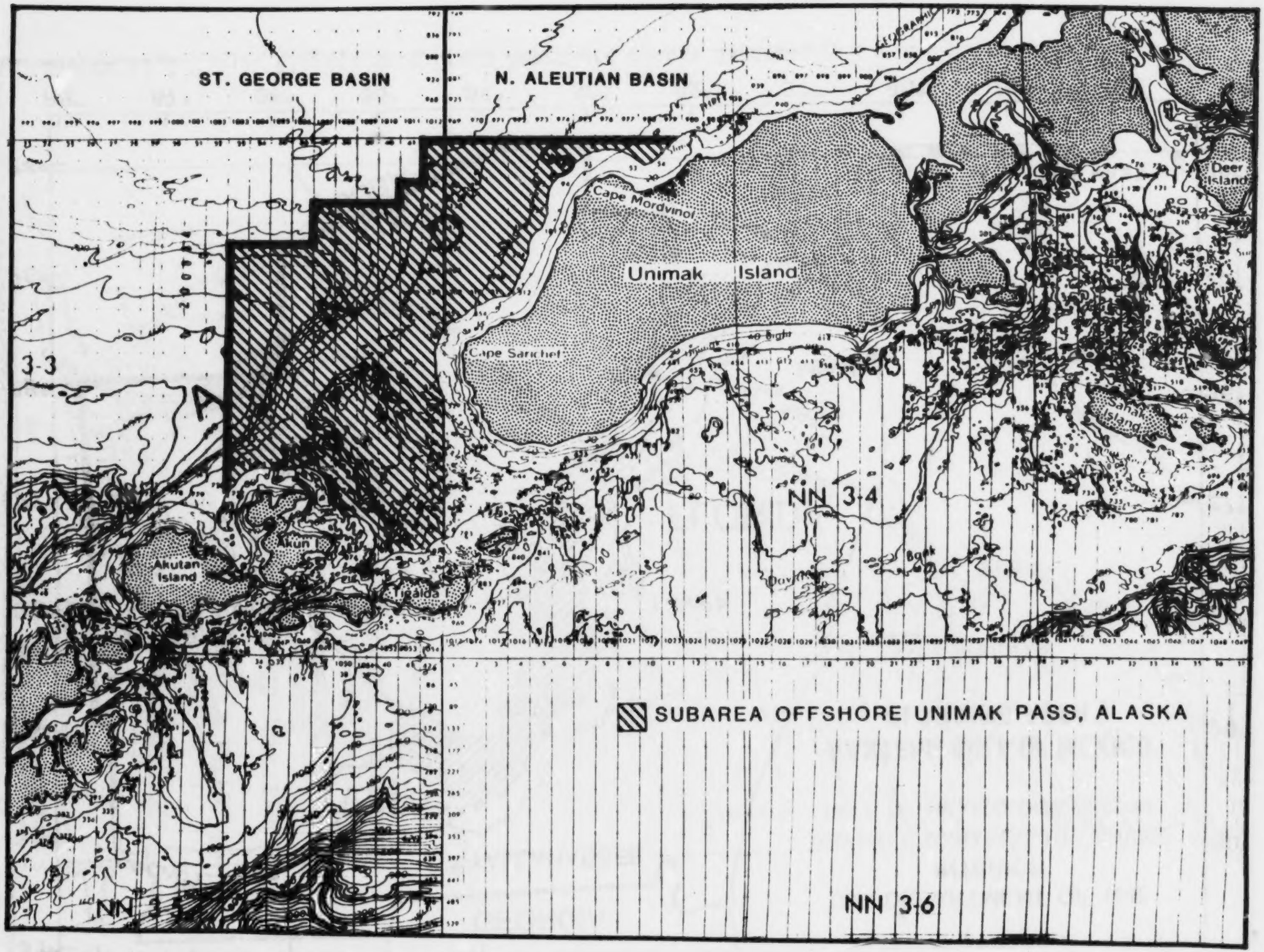


Figure II.A.2.a-4. Unimak Pass Subarea.

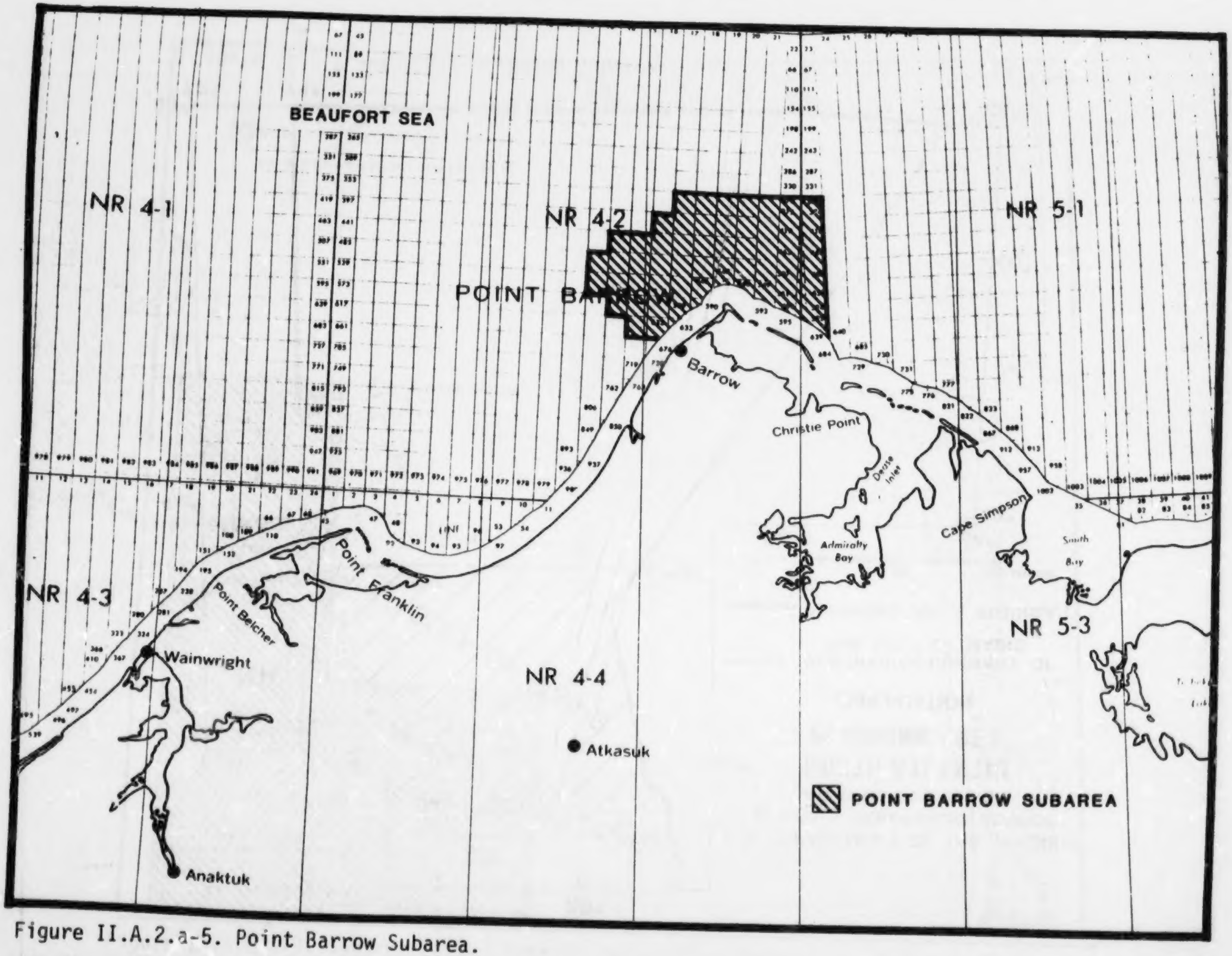


Figure II.A.2.a-5. Point Barrow Subarea.

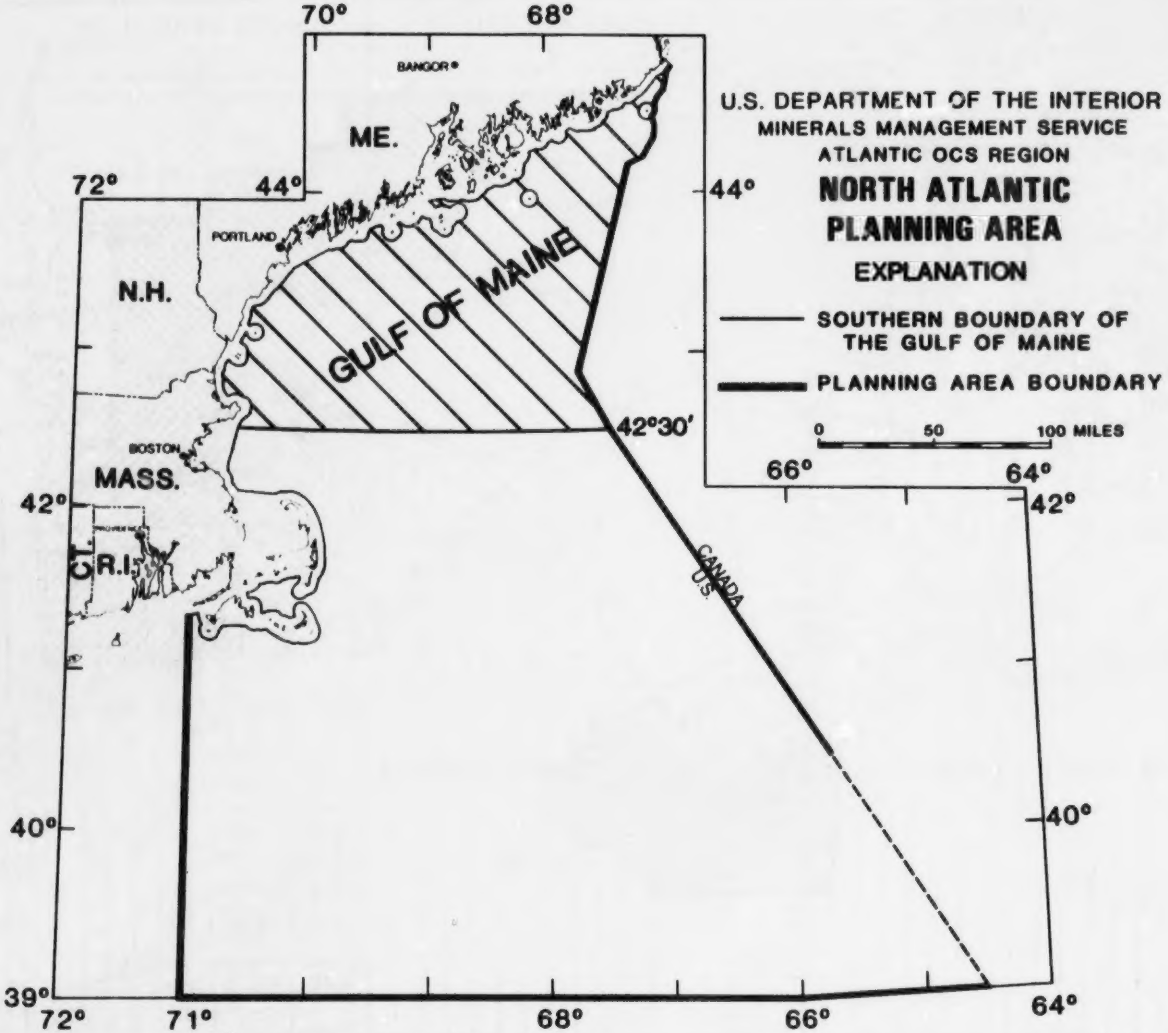


Figure II.A.2.a-6. Gulf of Maine Subarea.

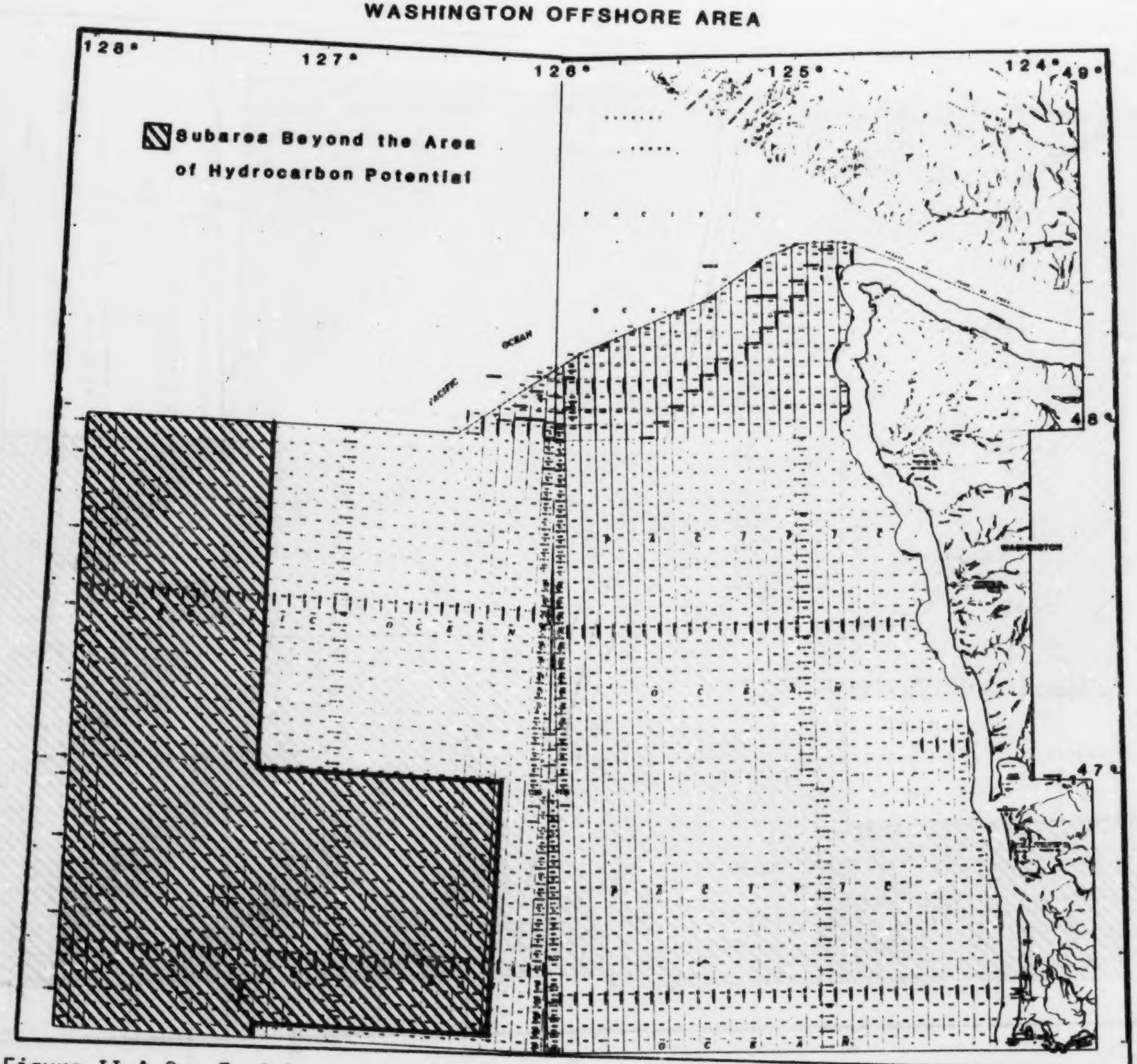


Figure II.A.2.a-7. Subarea Beyond Area of Hydrocarbon Potential - Offshore Washington.

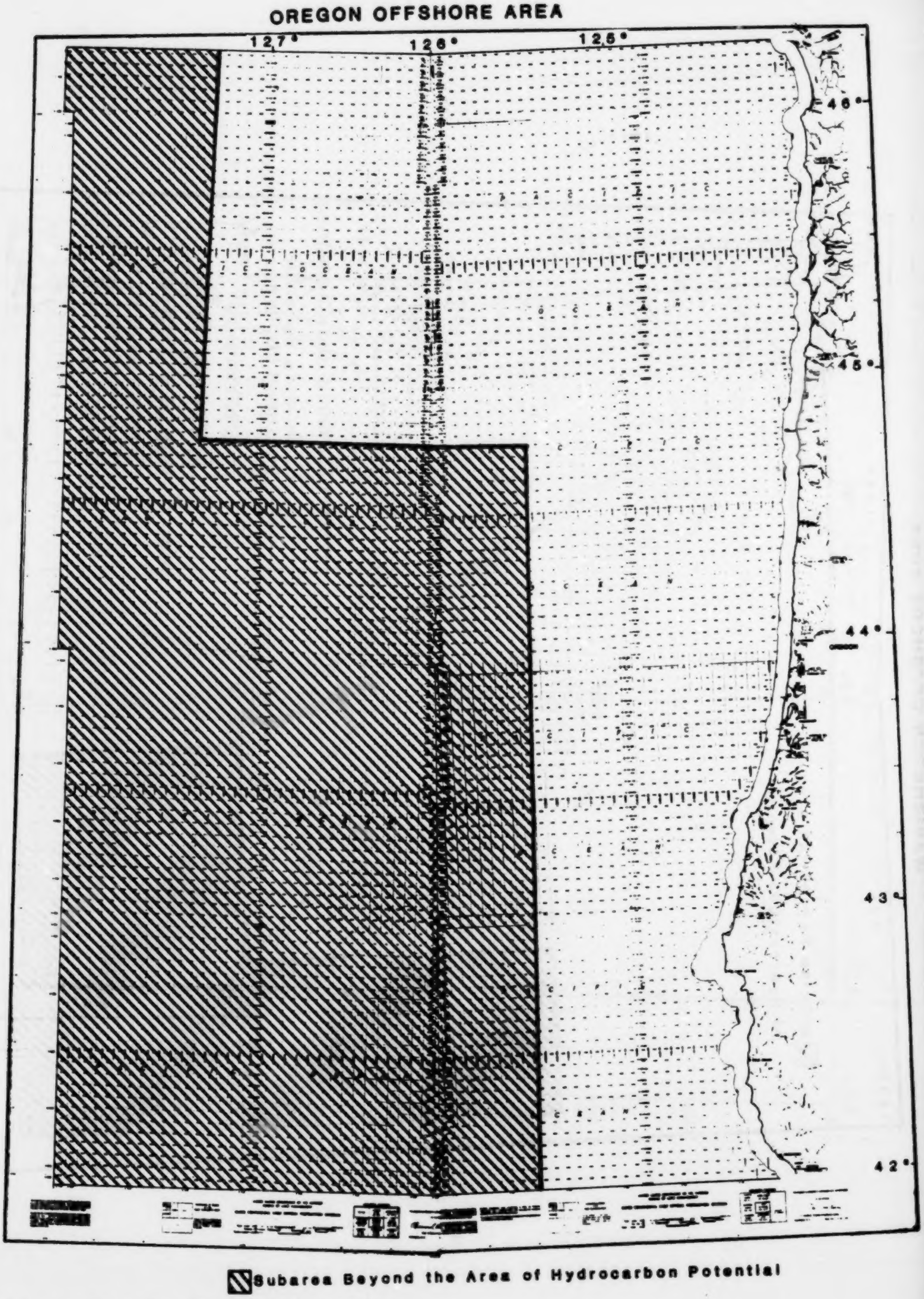


Figure II.A.2.a-8. Offshore Oregon.

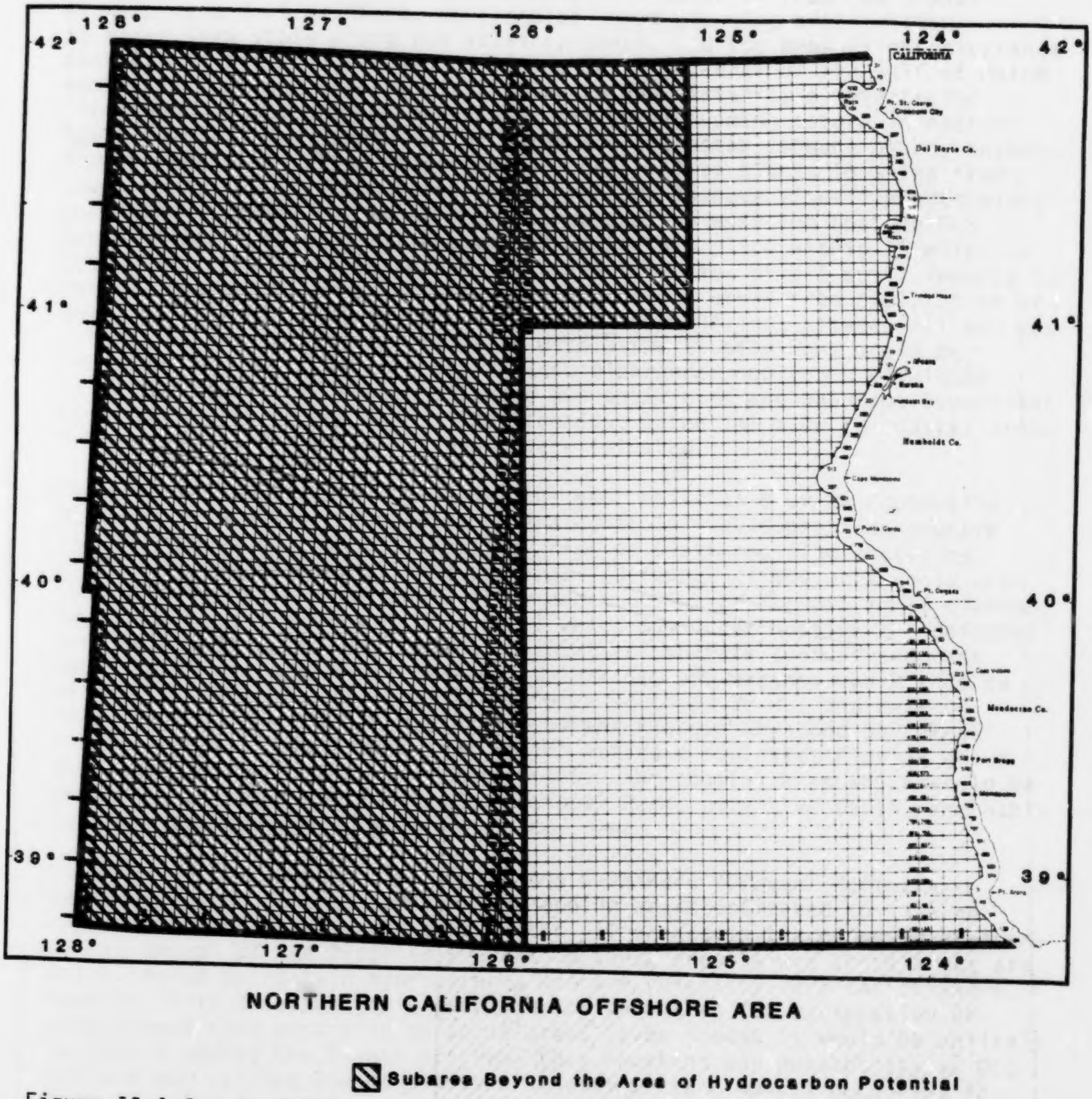


Figure II.A.2.a-9. Offshore Northern California.

Area beyond the area of hydrocarbon potential offshore Central California - This subarea consists of seaward portions of the planning area. (Figure II.A.2.a-10).

### b. Summary of Impacts

Five of the 13 subareas being considered for deferral from the 5-year program, the Gulf of Maine, portions of three planning areas within 15 miles from shore along the Atlantic coast, and the NASA flight clearance zone are in the Atlantic Region of the OCS. Deferral of the Gulf of Maine would preclude any onshore visual impacts and virtually eliminate the likelihood of any production-related oil spills coming ashore in eastern Massachusetts, New Hampshire, or Maine and the establishment of any onshore support facilties along these coasts. Deferral of blocks 15 miles from shore along the Atlantic coast would preclude onshore visual impacts along the Atlantic coast due to offshore structures by ensuring that no OCS exploration or development activities would take place within 15 miles of the coast. For the same reason, any potential risk of oil spill impacts to coastal recreation areas or sensitive biological areas from exploration or development would also be reduced. Potential conflicts between oil and gas activities and commercial fisheries within the 15-mile zone would be precluded. Deferral of the NASA flight clearance zone would eliminate potential conflicts between offshore OCS activities and NASA and Department of Defense uses of the zone. Additionally, potential risk to coastal areas from platform-related spills would be eliminated.

Deferral of nearshore blocks along the west coast of Florida (generally 30 miles from shore from Naples to Apalachicola) would preclude onshore visual impacts (due to visibility of rigs or platforms from shore) by precluding OCS structures from the area. Deferral of the area would provide a buffer zone which would allow additional time for oil spill cleanup, containment, or weathering of a spill which may occur outside the deferral area before it could reach shore. Sensitive habitats such as seagrass beds, coral reefs, barrier beaches, estuaries, and marshes would thus be offered protection. Deferral of the area south of 26°N., and east of 82°W. would offer similar protection to the Flordia Keys and southwest Florida coastal area and to that region offshore southwest Florida which contains diverse live bottom communities. The coastal area which would be protected includes the Everglades National Park, extensive marsh, and habitats for the endangered manatee and Key deer.

Deferral of the seaward portions of the Washington/Oregon, Northern California, and Central California planning areas estimated to have no hydrocarbon potential would make little difference in the expected environmental impact of the Proposed Program in these areas since these areas are not expected to contain hydrocarbons and are generally very far offshore. However, this deferral would preclude any potential for exploration or development from occurring in these areas (even though it would be unlikely to occur) during the 5-year program, thus negating any possibility of OCS oil and gas related use conflicts or environmental impacts occurring in these areas.

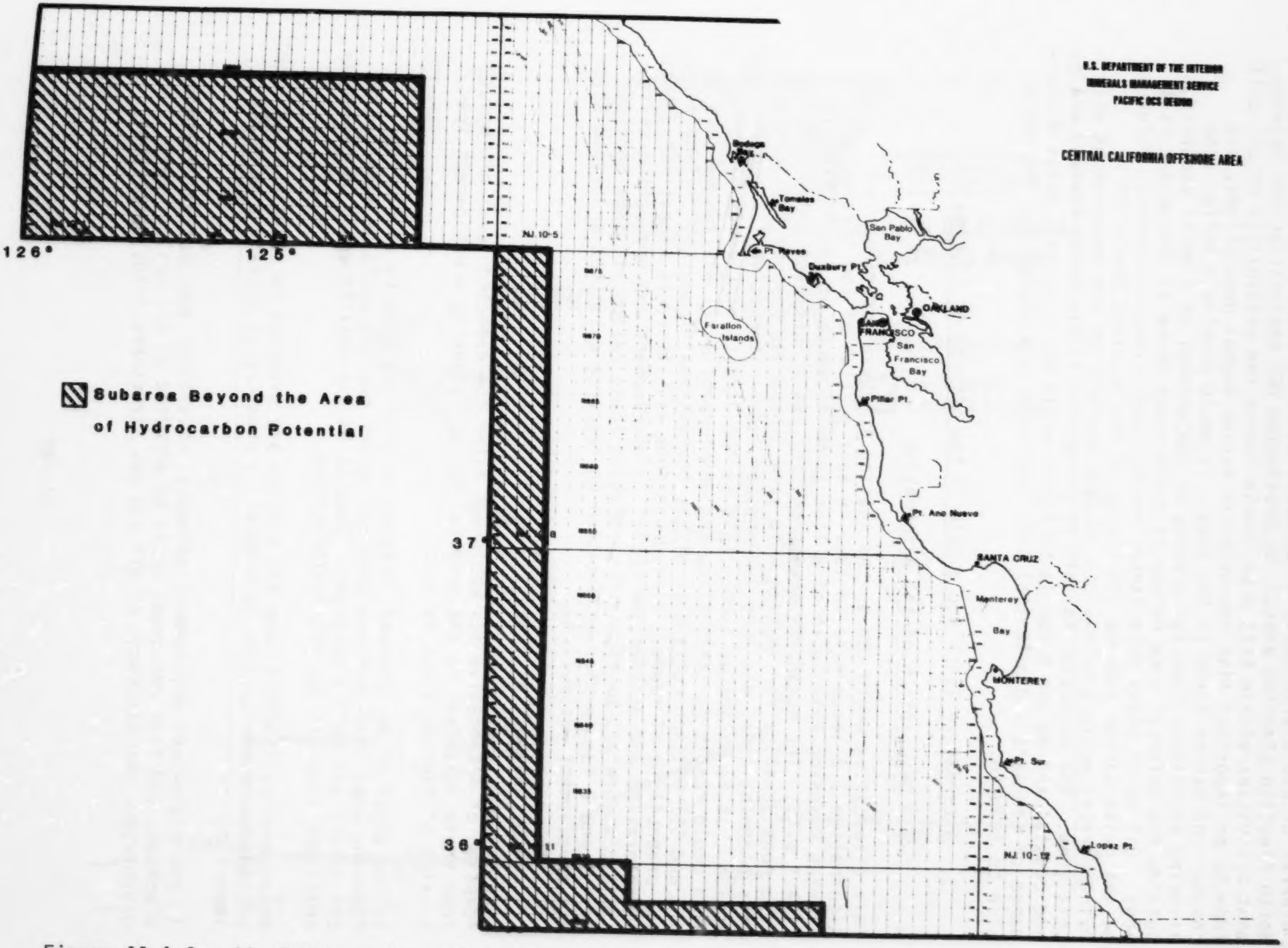


Figure II.A.2.a-10. Offshore Central California.

Deferral of 210 blocks north of Unimak Pass (portions of the St. George and North Aleutian planning areas), by precluding OCS exploration and development activities within this area, would reduce the possibility of oil spill impacts on important fish resources in marine mammal populations, and coastal and marine birds in the area. It would provide a buffer zone allowing additional time for cleanup or containment of a spill occurring outside the deferral area before it could reach shore in the Unimak Pass area. Oil spill risks from tanker traffic would remain, howver. Deferral of the Point Barrow subarea (59 blocks in the Beaufort Sea north of Point Barrow) would preclude oil and gas exploration and development within this area. The potential for oil spill impacts to migrating bowhead whales and coastal and marine birds in this area would be lessened. Noise disturbance of bowheads and potential conflicts with subsistence whaling could also be reduced.

### 3. Alternative III - Add a Sale in the Straits of Florida

#### a. Description of the Alternative

This alternative would add to the leasing schedule described in Alternative I a lease sale in 1991 in that portion of the Straits of Florida Planning Area south of a line 12 miles south of Miami (Figure II.A.3.a-1). The northern portion of the area is proposed to be deferred from consideration for leasing. To date, there has been no OCS leasing in this planning area, and none is proposed under Alternative I - The Proposed Action. It is estimated that a sale in the Straits of Florida planning area could result in the leasing and development of 21 million barrels of oil and 551 billion cubic feet of gas (conditional resources). (The marginal probability of commercial hydrocarbons is 0.11). It is estimated that 9 exploration and delineation wells, 13 development and production wells, and 1 platform may be required to develop these resources. See Sections IV.A.1 and 2 for further information on resource estimates and exploration and development assumptions.

#### b. Summary of Impacts

Adoption of Alternative III would not alter the expected level of impacts from those attendant to the proposal for all planning areas except the Straits of Florida planning area.

In the physical environment category, within the straits of Florida Planning Area (non-deferred portion), water quality could be affected by oil spills and well discharges. Impacts on air quality would be caused by emissions from oil and gas installations.

Water quality (onshore) and air quality are expected to sustain a low level of impact. Water quality (offshore) is expected to sustain a moderate impact.

In the biological environment category, intertidal and subtidal benthos, plankton, and fish resources could be affected by oil spills, well discharges, and placement of oil and gas structures (rigs, pipelines,

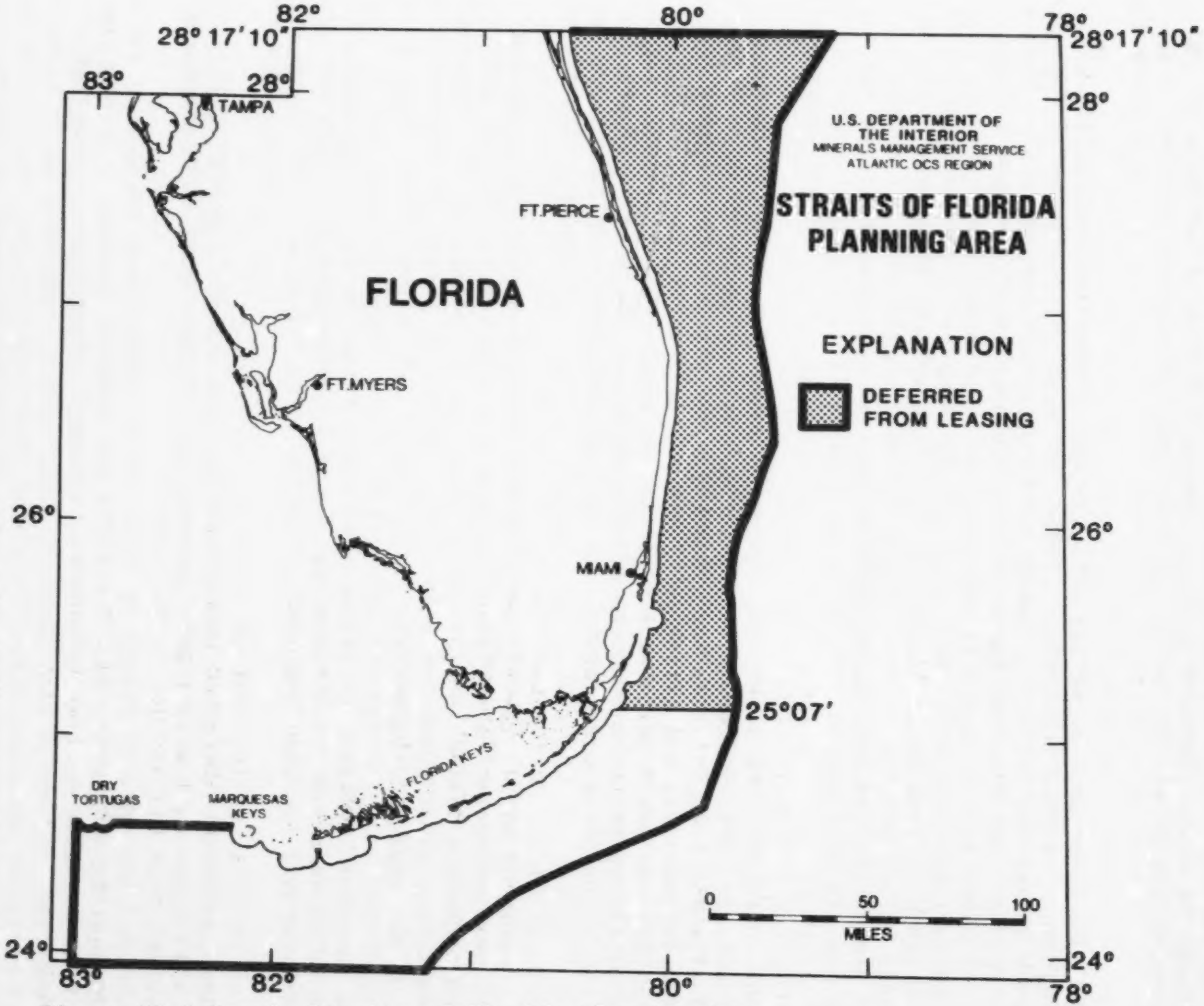


Figure II.A.3.a-1. Straits of Florida Planning Area.

platforms). Adverse impacts on marine mammals, coastal and marine birds, and endangered and threatened species could result from oil spills, noises from seismic surveying or vessel traffic, and encounters with vessel traffic. Estuaries and wetlands could be affected by oil spills and placement of oil and gas structures. Oil spills and placement of oil and gas structures, in addition to well discharges, could also affect areas of special concern. Marine sanctuaries could be impacted by oil spills and general OCS activities.

In the biological environment category, the following components could be expected to sustain a low level of impact: intertidal benthos, subtidal benthos, plankton, nonendangered marine mammals, coastal and marine birds, endangered and threatened species, and estuaries and wetlands. A high level of impact may occur for fish resources as a result of a large oil spill affecting the vulnerable species associated with reef and live-bottom habitats. Very high impacts may occur for the areas of special concern (live bottom and reef communities and *Oculina* banks) and the marine sanctuaries (Key Largo and Looe Key) which would be particulary vulnerable to effects of a large oil spill as well as mechanical damage from oil and gas structures.

In the socioeconomic environment category, employment and demographic conditions are affected by general OCS activities. Coastal land uses, marine vessel traffic and offshore infrastructure, and military uses are affected by placement of oil and gas structures. Oil spills and placement of oil and gas structures could cause an impact to commercial fisheries and archaeological resources. Adverse effects could be produced by oil spills, land use competition, and placement of oil and gas structures on recreational resources.

In the socioeconomic environment category, marine vessel traffic and offshore infrastructure, military uses, archaeological resources, and employment and demographic conditions (on a regional level) are expected to sustain very low levels of impact. Employment and demographic conditions (on a local level) would have impact levels that range from very low to low. A low level of impact would be expected for recreational resources, and a moderate level of impact could be expected for coastal land uses and water services. A high level of impact may occur for commercial fisheries as a result of a large oil spill affecting the coral reef or live bottom oriented species.

CUMULATIVE IMPACTS: In the physical environment category, moderate impacts are expected for water quality (onshore and offshore) and air quality.

In the biological environment, a low level of impact is expected for intertidal benthos, subtidal benthos, plankton, coastal and marine birds, and nonendangered marine mammls. Impacts on estuaries and wetlands are expected to be moderate. A high level of impact may occur for endangered and threatened species. Very high levels of impact could be sustained by fish resources, areas of special concern, and marine sanctuaries.

In the socioeconomic environment, impacts on military uses, and marine vessel traffic and offshore infrastructure are expected to be very low.

Moderate impacts are expected for recreational resources and cultural resources. A high level of impacts could be sustained for employment and demographic conditions, commercial fisheries, and coastal land uses and water services.

## 4. Alternative IV - Biennial Leasing

### a. Description of the Alternative

This alternative proposes a biennial pace of leasing in those planning areas which have triennial sales under Alternative I - The Proposed Action. This biennial pace of leasing increases by one the number of sales in the following planning areas: Mid-Atlantic, South Atlantic, Eastern Gulf of Mexico, Southern California, Central California, North Aleutian, St. George, Navarin, Norton, Chukchi, and Beaufort. However, this alternative retains the annual leasing pace in the Central and Western Gulf of Mexico planning areas and retains a single frontier exploration sale in the Gulf of Alaska, Cook Inlet, Kodiak, and Hope Basin Planning Areas. The total number of sales in the leasing schedule under this alternative is 48. (This represents an increase of 6 sales over the schedule in Alternative I - The Proposed Action, although 5 of the sales in the Proposed Action would be small supplemental sales). Under this alternative, it is assumed that the Secretary could choose to implement a leasing schedule incorporating a biennial pace of leasing in any or all of the planning areas evaluated.

Table II.A.4-1 shows the leasing schedule according to this alternative, and Table II.A.4-2 presents the resource estimates and exploration and development information for this alternative.

### b. Summary of Impacts

#### (1) Atlantic Region

Adoption of Alternative IV would not alter the expected level of impacts from those attendant to the proposal for the three Atlantic (North, Mid, and South) Planning Areas.

By this alternative, one sale is added in the Mid- and South Atlantic Planning Areas. The number of sales in the North Atlantic Planning Area remains unchanged at two. Although the calculated number of oil spills greater than 1,000 bbl increases (to 0.21 for the Mid-Atlantic and 0.45 for the South Atlantic, Table IV.A.4.a.5), the assumed number of spills (greater than 1,000 bbl) remains at one--the same as for the Proposed Action.

By this alternative, the number of wells and production platforms in the Mid- and South Atlantic Planning Areas is approximately twice as great (Table II.A.4-2) as for the Proposed Action (Table II.A.1.b-2). In turn, the volume of muds, cuttings, and formation waters discharged in these areas also approximately doubles in comparison to the Proposed Action (see Section IV.A.2.a and IV.A.2.b, Exploration and Development Assumptions). However, because of dilution, dispersion, etc., in receiving water, the

Table II.A.4-1
Current Leasing Schedule Overlap with Alternative IV (Biennial Sales)

| | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | Sales |
|---|---|---|---|---|---|---|---|---|---|---|
| ATLANTIC | | | | | | | | | | 6 |
| North | | 82 | | | | 96 | | S | | |
| Mid- | 76 | | | 111 | | S | | S | | |
| South | 78 | | | 90 | | 108 | | S | | |
| GULF OF MEXICO | | | | | | | | | | 13 |
| Western | 74 | 84 | 102 | 105 | S | S | S | S | S | |
| Central | 72 | 81 | 98 | 104 | 110 | S | S | S | S | |
| Eastern | 69(II) | 79 | 94 | | S | | S | | S | |
| PACIFIC | | | | | | | | | | 8 |
| Southern CA | | 80 | | | 95 | | S | | S | |
| Central CA | 73 | | | | | S | | S | | |
| Northern CA | | | | | | 91 | | S | | |
| Washington-Oregon | | | | | | | | | S | |
| ALASKA | | | | | | | | | | 21 |
| Beaufort Sea | | 87 | | | 97 | | S | | S | |
| Chukchi Sea | | | | | 109 | | S | | S | |
| Norton Basin | 57 | | | 100 | | S | | S | | |
| Navarin Basin | | 83 | | | 107 | | S | | S | |
| St. George Basin | 70 | | | 89 | | 101 | | | S* | |
| N. Aleutian Basin | | | | 92 | | S | | S | | |
| Shumagin | | | | | | 86 | | | S | |
| Gulf of Alaska | | | 88 | | | S | | | | |
| Cook Inlet | | | | | | | | | S | |
| Kodiak | | | | | | | | | S | |
| Hope | | | | | | | | | S | |
| | | | | | | | | | Total | 48 |

Sales to the left of the vertical line are in the current 5-year leasing schedule. Sales to the right of the vertical line are part of the alternative to the Proposed Program.

s = Sale not yet numbered. Sale numbers are those in the 1982 program.

*The 26-month presale process for Alaska OCS sales results in the appearance that some of the areas proposed for biennial leasing have triennial leasing. A monthly schedule would show that the following 8 areas are proposed in this option for leasing as near to biennial as possible: southern, central, and northern California; eastern Gulf of Mexico; Beaufort Sea; Navarin Basin; St. George Basin; and North Aleutian Basin.

## Table II.A.4-2
## Conditional oil and gas resources and infrastructure for Alternative 4
## (Biennial Sales in Areas of Triennial Leasing in Proposed Program)

| Planning Area | No. Sales | Conditional Resources Oil (Million bbls) | Conditional Resources Gas (BCF) | Million BOE | Marginal Probability of Commercial Hydrocarbons | No. Exploratory and Delineation Wells | No. Development/ Production Wells | No. Platforms | Delineation Wells First Year | Delineation Wells Last Year | Delineation Wells Period of most intense activity | Platforms First Year | Platforms Last Year | Platforms Period of most intense activity | Production Wells First Year | Production Wells Last Year | Production Wells Period of most intense activity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N. Atlantic | 2 | 49 | 961 | 220 | 0.30 | 18 | 26 | 2 | 1990 | 1993 | 1991 | 1996 | 1997 | 1996-97 | 1997 | 2000 | 1998 |
| Mid-Atlantic | 2 | 47 | 777 | 185 | 1.00 | 17 | 21 | 2 | 1990 | 1993 | 1991-92 | 1995 | 1996 | 1995-96 | 1996 | 1998 | 1997 |
| S. Atlantic | 2 | 138 | 2589 | 598 | 0.25 | 22 | 70 | 2 | 1990 | 1993 | 1992 | 1995 | 1996 | 1995-96 | 1996 | 1999 | 1997 |
| W. GOM | 5 | 437 | 6155 | 1532 | 1.00 | 713 | 912 | 76 | 1988 | 2000 | 1992-96 | 1992 | 2005 | 1995-98 | 1992 | 2006 | 1996-98 |
| C. GOM | 5 | 1004 | 8286 | 2479 | 1.00 | 1246 | 1596 | 133 | 1988 | 2001 | 1992-97 | 1992 | 2005 | 1996-99 | 1992 | 2006 | 1997-99 |
| E. GOM | 3 | 86 | 460 | 168 | 1.00 | 28 | 51 | 3 | 1989 | 1995 | 1991 | 1994 | 1998 | 1994,96,98 | 1995 | 2001 | 1997 |
| Wash./Oregon | 1 | 58 | 1043 | 243 | 0.20 | 10 | 29 | 1 | 1993 | 1995 | 1995 | 1998 | 1998 | 1998 | 1999 | 2001 | 1999-2000 |
| N. Calif. | 2 | 231 | 1023 | 413 | 0.60 | 20 | 48 | 2 | 1990 | 1993 | 1991 | 1996 | 1997 | 1996-97 | 1997 | 2000 | 1998-99 |
| C. Calif. | 2 | 297 | 419 | 371 | 0.65 | 20 | 43 | 2 | 1990 | 1993 | 1991-92 | 1995 | 1996 | 1995-96 | 1996 | 1999 | 1997 |
| S. Calif. | 3 | 524 | 823 | 670 | 1.00 | 231 | 525 | 11 | 1988 | 1994 | 1992 | 1992 | 1997 | 1995 | 1992 | 1999 | 1995-96 |
| Gulf of Alaska | 1 | 113 | 1751 | 425 | 0.08 | 12 | 42 | 1 | 1990 | 1994 | 1990-91 | 1998 | 1998 | 1998 | 1998 | 2002 | 1998-2001 |
| Kodiak | 1 | 95 | 1840 | 422 | 0.05 | 12 | 42 | 1 | 1993 | 1998 | 1993 | 2001 | 2001 | 2001 | 2002 | 2007 | 2002-06 |
| Cook Inlet | 1 | 179 | 298 | 231 | 0.03 | 10 | 23 | 1 | 1993 | 1997 | 1993 | 2000 | 2000 | 2000 | 2001 | 2003 | 2001-02 |
| Shumagin | 2 | 48 | 1363 | 291 | 0.03 | 9 | 30 | 1 | 1992 | 1996 | 1992-93 | 1999 | 1999 | 1999 | 2000 | 2003 | 2000-02 |
| N. Aleutian | 2 | 180 | 1310 | 413 | 0.20 | 12 | 41 | 1 | 1990 | 1995 | 1990-91 | 1999 | 1999 | 1999 | 2000 | 2005 | 2000-04 |
| St. George | 2 | 270 | 2522 | 719 | 0.22 | 22 | 70 | 2 | 1990 | 1994 | 1991-92 | 1997 | 1998 | 1997-98 | 1998 | 2003 | 1999-2001 |
| Navarin | 3 | 2208 | 2686 | 2686 | 0.27 | 93 | 263 | 8 | 1989 | 1995 | 1992 | 1998 | 2002 | 1998-2000 | 1998 | 2006 | 2001 |
| Norton | 2 | 122 | 559 | 221 | 0.15 | 10 | 21 | 1 | 1990 | 1993 | 1990-92 | 1997 | 1997 | 1997 | 1998 | 2000 | 1998-99 |
| Hope | 1 | 145 | 1539 | 418 | 0.02 | 13 | 40 | 1 | 1993 | 1997 | 1993-96 | 2001 | 2001 | 2001 | 2002 | 2006 | 2002-06 |
| Chukchi Sea | 3 | 1501 |  | 1501 | 0.20 | 48 | 147 | 4 | 1989 | 1995 | 1992 | 1997 | 1999 | 1998 | 1998 | 2005 | 2000-01 |
| Beaufort | 3 | 666 |  | 666 | 0.70 | 22 | 65 | 2 | 1989 | 1993 | 1990-91 | 1997 | 1998 | 1997-98 | 1998 | 2002 | 1999-2001 |
|  | 48 | 3989* | 20,445* | 7626* |  |  |  |  |  |  |  |  |  |  |  |  |  |

*These are totals of risked developable resource estimates and not the sum of the conditional estimates in the columns above. See Section IV.A.1. for a discussion regarding aggregation of resources estimates.

increase in these routine discharges would result in primarily local effects and is not anticipated to result in a substantial increase in impacts above that expected for the Proposed Action.

### (2) Gulf of Mexico Region

This alternative would add one sale to the Eastern Gulf Planning Area but would make no change in the annual pace of leasing in the Western and Central Gulf. In the Eastern Gulf, the additional sale would result in no change in the assumed number of oil spills; it would remain at one assumed spill. The number of wells would increase from 55 to 79, and one additional platform would be built. This would result in an increase in drill muds from 250,250 barrels to 350,000 barrels, still a small total amount given the volume of water available for dilution of this kind of effluent. Areawide impacts in the Eastern Gulf could, therefore, be expected to remain the same. Localized inpacts expected to occur in the immediate vicinity of exploratory wells and platforms would increase very slightly.

### (3) Pacific Region

Selection of Alternative IV would not increase the number of sales nor affect the development assumptions in Northern California; however, the number of sales in Central California would increase from one to two, and the number of sales in Southern California would increase from two to three.

The resource estimates in Central California increase from 207 mbbls of oil and 292 BCF of gas for the Proposed Action to 297 mbbls of oil and 419 BCF of gas for Alternative IV. Increases in development assumptions are as follows: platforms would increase from one to two; drill muds and cuttings would increase from 185,000 bbls to 285,000 bbls; formation waters would increase from 155.2 mbbls to 222.7 mbbls; population and employment would remain about the same; and the assumed number of spills would remain at one.

Although localized potential impacts may be more extensive due to the addition of one platform, the relatively minor increase in offshore oil and gas activities within the planning area would not significantly affect overall impact levels. Impact levels from Alternative IV would be approximately the same as for Alternative I.

The resource estimates for Southern California increase from 462 mbbls of oil and 726 BCF of gas for Alternative I to 524 mbbls of oil and 823 BCF of gas for Alternative IV. Increases in development assumptions are as follows: the number of platforms increases from 10 to 11; drill muds and cuttings increase from 3,070,000 bbls to 3,403,000 bbls; formation waters increase from 346.5 mbbls to 393.5 mbbls; population and employment would probably not increase significantly; and the assumed number of spills remains at two.

These relatively small increases in development activities are not expected to increase significantly the level of impacts to resources in the Southern

California Planning Area as a whole from those identified under Alternative I. The addition of one platform, of course, would extend the potential localized effects of drilling muds and formation waters to the location of that additional platform.

### (4) Alaska Region

Assumptions and sales for Alternative IV are the same as for the proposal for the following planning areas: Gulf of Alaska, Kodiak, Cook Inlet, Shumagin, and Hope since no sales would be added in these planning areas. The differences between Alternative I and Alternative IV in the other Alaska planning areas are described below.

Alternative IV adds one sale to the St. George Planning Area. Resource estimates increase from 135 to 270 MMbbls of oil and 1,261 to 2,522 TCF of gas. The number of exploration wells increases from 11 to 22, and development and production wells from 35 to 70. The number of platforms increase from one to two. The assumed number of oil spills remains at one. The amount of drill muds increases from 519,940 bbls to 1.5 million bbls; formation waters increase from 17 to 1,500 bbls to 34 to 3,000 mbbls. New employment figures increase from 97 to 585 to 1,000, and new population figures increase from 640 to 1,200. Although the resource estimates and development assumptions approximately double with this alternative, the increase in the amounts of activities and expected effluent discharges are not large enough to significantly effect the impact levels described for the Proposed Action. Regional and local impact levels are expected to remain the same as for the proposal on all components of the physical, biological, and socioeconomic environments. Localized impacts may be slightly more extensive due to the one additional platform.

Alternative IV adds one sale to the North Aleutian Planning Area. Resources estimates increase from 173 to 180 MMbbls of oil and 1,258 to 1,310 TCF of gas. The number of development and production wells increases from 30 to 41. The number of platforms remains at one. The assumed number of oil spills remains at one. Regional and local impact levels remain the same as for the proposal except for forage fish. Overall, effects of activities associated with this accelerated lease schedule on regional populations of herring and other forage fish are expected to be low; however, impacts on local populations could be moderate.

Alternative IV adds one sale to the Navarin Planning Area. Resource estimates increase from 1,920 to 2,208 MMbbls of oil and 2,336 to 2,686 TCF of gas. The number of exploration wells increases from 82 to 83, and devleopment and production wells increase from 229 to 263. The number of platforms increases from seven to eight. The assumed number of oil spills remains at six. The amount of drill muds increases from 485,119 bbls to 55,000 bbls; cuttings increase from 1,200,417 bbls to 1,370,500 bbls; formation waters increase from 10 to 150 mbbls to 12 to 170 mbbls. New employment figures increase from 200 to 4,000 to 250 to 4,100, and new population figures increase from 325 to 370. Regional and local impact levels remain the same as for the proposal for all components of the physical and biological environments and for all but subsistence and sociocultural impacts of the socioeconomic environment. Subsistence and sociocultural impact levels could be moderate.

Alternative IV adds one sale to the Norton Planning Area. Resource estimates increase from 102 to 122 MMbbls of oil and 470 to 559 TCF of gas. The number of development and production wells increases from 18 to 21. The number of platforms remains at one. The assumed number of oil spills remains at one. The amount of drill muds increases from 106,905 bbls to 160,000 bbls; cuttings increase from 101,190 bbls to 133,000 bbls; formation waters increase from 3.5 to 250 mbbls to 4 to 300 mbbls. Regional and local impact levels remain the same as for the proposal for all components of the physical and socioeconomic environments except sociocultural impacts which could be moderate rather than low. Impacts on some components of the biological environment may increase slightly from those of the proposal. Impacts on fish resources may be moderate. Impacts on walruses and ice seals are expected to be no more than moderate; impacts may be low on polar bears, and very low on nonendangered cetaceans.

Alternative IV adds one sale to the Chukchi Sea Planning Area. Resource estimates increase from 1,152 to 1,501 MMbbls of oil. The number of exploration wells increases from 37 to 48, and the number of development and production wells from 105 to 147. The number of platforms increases from three to four. The assumed number of oil spills increase from three to four. The amount of drill muds increases from 458,690 bbls to 550,000 bbls; cuttings increase from 511,548 bbls to 544,000 bbls; formation waters increase from 10 to 500 mbbls to 12 to 625 mbbls. Regional and local impact levels remain the same as for the proposal on all components of the physical, biological, and socioencominc environments.

Alternative IV adds one sale to the Beaufort Sea Planning Area. Resource estimates increase from 627 to 666 MMbbls of oil. The number of exploration wells increases from 11 to 22, and development and production wells increase from 61 to 65. The number of platforms remains at two. the assumed number of oil spills remains at two. The amount of drill muds increases from 154,762 bbls to 175,000 bbls; cuttings increase from 344,345 bbls to 410,000 bbls; formation waters increase from 7.5 to 375 mbbls to 10 to 405 mbbls. Regional and local impact levels remain the same as for the proposal on all components of the physical, biological, and socioeconomic environments.

### 5. Alternative V - The Acceleration Provision

#### a. Description of the Alternative

This alternative evaluates the effects of the implementation of the acceleration provision in all planning areas which have a triennial pace of leasing under Alternative I, but would add no new sales in any planning area to the leasing schedule. This alternative, therefore, includes the same number of sales (42) as Alternative I. Only the timing of sales would differ.

The DOI must plan for an unknown future with limited information. Changes in the world energy market, as well as exploration results in frontier areas, can dramatically affect the demand for offshore leases. The statutory requirement to develop a schedule which will best meet energy needs must be applied with due recognition that what will be known tomorrow may be very well different from what is known today. Thus, the 5-year program needs to have flexibility to adjust to major unforeseen developments. One means of providing such flexibility is the following provision to permit the acceleration of the pace of leasing frmm triennial to biennial if certain carefully defined criteria are met.

Two provisions of the OCSLA which appear to be most applicable to the acceleration proposal are sections 18(a) and 18(e). Section 18(a) provides that:

> . . . The leasing program shall consist of a schedule of proposed lease sales indicating, as precisely as possible, the size, timing, and location of leasing activity which he [the Secretary] determines will best meet national energy needs for the five-year period following its approval or reapproval . . . .

The acceleration provision complies with section 18(a) in that the high degree of uncertainty about future hydrocarbon supplies and prices and about the location of future discoveries make such flexibility necessary in order to meet national energy needs.

Section 18(e) provides that:

> The Secretary shall review the leasing program approved under this section at least once a year. He may revise and reapprove such program, at any time, and such revision and reapproval, except in the case of a revision which is not significant, shall be in the same manner as originally developed.

Thus, the Secretary could, "at any time," review the leasing program and make a revision of it. The purpose of including the acceleration provision as part of an approved leasing program is so that its exercise would be the implementation of part of the approved program rather than a significant revision of it. The DOI has numerous times exercised the authority to decelerate leasing in an area, and that procedure would remain unchanged.

Criteria for Implementation: In the Federal Register Notice of March 22, 1985, announcing the Draft Proposed Program, it was explained that the acceleration provision

> . . . would be used only if warranted by changes in economic conditions (for example, substantially higher oil price expectations such as might result from a serious oil

supply disruption) or geologic data (such as could come from major new discoveries). The question of whether to accelerate a sale in an area would be made on a sale-by-sale basis, as part of the required annual review of the program under section 18(e). No new sales would be added to the program in any planning area under this provision. A number of potential criteria for implementing the acceleration provision are discussed in the Federal Register Notice answering the Proposed Program.

The Secretary will not accelerate a sale unless he makes a finding that acceleration from triennial to biennial leasing is permissible on both environmental and multiple-use grounds.

The Secretary's decision to accelerate a sale would be conveyed to the Governors of affected States and announced in a Federal Register Notice at the initiation of the 2-year presale process. Responses from Governors, localities, and other affected parties would be considered along with responses received in connection with the standard presale consultation steps, beginning with the Call. Objections to the acceleration of any sale, or reconsideration on the part of the Secretary for other reasons, could result in a decision by the Secretary to restore the sale to a triennial pacing.

The proposed program includes the provision to accelerate sales in eight areas of higher value or higher interest. The potential effects of invoking the acceleration provision in those eight areas as well as in other planning areas which are proposed to have triennial lease sales are examined in this alternative. For purposes of analysis, it is assumed that all triennial sales are accelerated to a biennial pace, but no new sales (beyond the number included in the Proposed Program) would be added to the schedule.

Table II.A.5-1 shows the leasing schedule for this alternative, and Table II.A.5-2 presents the resource estimates and exploration and development information for this alternative.

### b. Summary of Impacts

By this alternative there would be the same number of sales in all the planning areas as in the proposed action, however, the time between the sales would be reduced in some planning areas. (Table II.A.5-1).

Under this alternative the estimated number of oil spills greater than 1,000 bbl (Table IV.A.4.a.6) is essentially unchanged from that calculated for the proposed action (Table IV.A.4.a.1). Also, the infrastructure (number of wells, platforms, etc., Table II.A.5-2) remains the same. Thus, the volume of routine discharges (drill muds, cuttings and formation waters) released would remain unchanged relative to the proposed action (See Section IV.A.2.a, Exploration and Development Assumptions).

Under this alternative, since lease sales may be held one year earlier than in Alternative I, impact-causing factors resulting from these sales would

## Table II.A.5-1
## Current Leasing Schedule Overlap with Alternative V (Acceleration Provision)

| | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | Sales |
|---|---|---|---|---|---|---|---|---|---|---|
| ATLANTIC************************ | | | | | | | | | | 4 |
| North | | 82 | | | | 96 | | S | | |
| Mid- | 76 | | | 111 | | S | | | | |
| South | 78 | | | 90 | | 108 | | | | |
| GULF OF MEXICO****************** | | | | | | | | | | 12 |
| Western | 74 | 84 | 102 | 105 | S | S | S | S | S | |
| Central | 72 | 81 | 98 | 104 | 110 | S | S | S | S | |
| Eastern | 69(II) | 79 | 94 | | S | | S | | | |
| PACIFIC************************* | | | | | | | | | | 6 |
| Southern CA | | 80 | | | 95 | | S | | | |
| Central CA | 73 | | | | | S | | | | |
| Northern CA | | | | | | 91 | | S | | |
| Washington-Oregon | | | | | | | | | S | |
| ALASKA************************** | | | | | | | | | | 15 |
| Beaufort Sea | | 87 | | | 97 | | S | | | |
| Chukchi Sea | | | | | 109 | | S | | | |
| Norton Basin | 57 | | | 100 | | S | | | | |
| Navarin Basin | | 83 | | | 107 | | S | | | |
| St. George Basin | 70 | | | 89 | | 101 | | | | |
| N. Aleutian Basin | | | | 92 | | S | | | | |
| Shumagin | | | | | | 86 | | | S | |
| Gulf of Alaska | | | 88 | | | S | | | | |
| Cook Inlet | | | | | | | | | S | |
| Kodiak | | | | | | | | | S | |
| Hope | | | | | | | | | S | |
| | | | | | | | | | Total | 37 |

Total (including supplemental sales)-42

Sales to the left of the vertical line are in the current 5-year leasing schedule. Sales to the right of the vertical line are part of the alternative to the Proposed Program.

s = Sale not yet numbered. Sale numbers are those in the 1982 program.

*The 26-month presale process for Alaska OCS sales results in the appearance that some of the areas proposed for biennial leasing have triennial leasing. A monthly schedule would show that the following 8 areas are proposed in this option for leasing as near to biennial as possible: southern, central, and northern California; eastern Gulf of Mexico; Beaufort Sea; Navarin Basin; St. George Basin; and North Aleutian Basin.

## Table II.A.5-2
## Conditional oil and gas resources and infrastructure for Alternative 5
## Acceleration Provision

|  |  | Conditional Resources |  |  |  |  |  |  | Delineation Wells |  |  | Platforms |  |  | Production Wells |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Planning Area | No. Sales | Oil (Million bbls) | Gas (BCF) | Million BOE | Marginal Probability of Commercial Hydrocarbons | No. Exploratory and Delineation Wells | No. Development/ Production Wells | No. Platforms | First Year | Last Year | Period of most intense activity | First Year | Last Year | Period of most intense activity | First Year | Last Year | Period of most intense activity |
| N. Atlantic | 2 | 49 | 961 | 220 | 0.30 | 18 | 26 | 2 | 1990 | 1993 | 1991 | 1996 | 1997 | 1996-97 | 1997 | 2000 | 1998 |
| Mid-Atlantic | 1 | 25 | 419 | 100 | 1.00 | 9 | 11 | 1 | 1990 | 1992 | 1990-92 | 1995 | 1995 | 1995 | 1996 | 1997 | 1996 |
| S. Atlantic | 1 | 69 | 1294 | 299 | 0.25 | 11 | 35 | 1 | 1990 | 1992 | 1991-92 | 1995 | 1995 | 1995 | 1996 | 1998 | 1996-7 |
| W. GOM | 5 | 437 | 6155 | 1532 | 1.00 | 13 | 912 | 76 | 1988 | 2000 | 1992-96 | 1992 | 2005 | 1995-98 | 1992 | 2006 | 1996-98 |
| C. GOM | 5 | 1004 | 8286 | 2479 | 1.00 | 6 | 1596 | 133 | 1988 | 2001 | 1992-97 | 1992 | 2005 | 1996-99 | 1992 | 2006 | 1997-99 |
| E. GOM | 2 | 62 | 329 | 120 | 1.00 | 19 | 36 | 2 | 1989 | 1992 | 1991 | 1994 | 1996 | 1994,96 | 1995 | 1999 | 1997 |
| Wash./Oregon | 1 | 58 | 1043 | 243 | 0.20 | 10 | 29 | 1 | 1993 | 1995 | 1995 | 1998 | 1998 | 1998 | 1999 | 2001 | 1999-2000 |
| N. Calif. | 2 | 231 | 1023 | 413 | 0.60 | 20 | 48 | 2 | 1990 | 1993 | 1991 | 1996 | 1997 | 1996-97 | 1997 | 2000 | 1998-99 |
| C. Calif. | 1 | 207 | 292 | 259 | 0.65 | 11 | 30 | 1 | 1990 | 1992 | 1991-92 | 1995 | 1995 | 1995 | 1996 | 1998 | 1996-97 |
| S. Calif. | 2 | 400 | 629 | 512 | 1.00 | 176 | 400 | 10 | 1988 | 1994 | 1990-91 | 1992 | 1997 | 1993-94 | 1992 | 1999 | 1994 |
| Gulf of Alaska | 1 | 113 | 1751 | 425 | 0.08 | 12 | 42 | 1 | 1990 | 1994 | 1990-91 | 1998 | 1998 | 1998 | 1998 | 2002 | 1998-2001 |
| Kodiak | 1 | 95 | 1840 | 422 | 0.05 | 12 | 42 | 1 | 1993 | 1998 | 1993 | 2001 | 2001 | 2001 | 2002 | 2007 | 2002-06 |
| Cook Inlet | 1 | 179 | 298 | 231 | 0.03 | 10 | 23 | 1 | 1993 | 1997 | 1993 | 2000 | 2000 | 2000 | 2001 | 2003 | 2001-02 |
| Shumagin | 2 | 48 | 1363 | 291 | 0.03 | 9 | 30 | 1 | 1992 | 1996 | 1992-93 | 1999 | 1999 | 1999 | 2000 | 2003 | 2000-02 |
| N. Aleutian | 1 | 173 | 1258 | 397 | 0.20 | 12 | 39 | 1 | 1990 | 1995 | 1990-91 | 1999 | 1999 | 1999 | 2000 | 2004 | 2000-03 |
| St. George | 1 | 135 | 1261 | 369 | 0.22 | 11 | 35 | 1 | 1990 | 1993 | 1990-92 | 1997 | 1997 | 1997 | 1998 | 2002 | 1998-2001 |
| Navarin | 2 | 1920 | 2336 | 2336 | 0.27 | 82 | 229 | 7 | 1989 | 1993 | 1990-92 | 1998 | 2002 | 1998-1999 | 1998 | 2006 | 2001 |
| Norton | 1 | 102 | 470 | 186 | 0.15 | 10 | 18 | 1 | 1990 | 1993 | 1990-92 | 1997 | 1997 | 1997 | 1998 | 2000 | 1998-99 |
| Hope | 1 | 145 | 1539 | 418 | 0.02 | 13 | 40 | 1 | 1993 | 1997 | 1993-96 | 2001 | 2001 | 2001 | 2002 | 2006 | 2002-06 |
| Chukchi Sea | 2 | 1152 |  | 1152 | 0.20 | 37 | 105 | 3 | 1989 | 1994 | 1990-92 | 1997 | 1998 | 1998 | 1998 | 2003 | 1999-2001 |
| Beaufort | 2 | 627 |  | 627 | 0.70 | 22 | 61 | 2 | 1989 | 1993 | 1990-91 | 1997 | 1998 | 1997-98 | 1998 | 2002 | 1999-2000 |
|  | 37 | 3534* | 18,960* | 6908* |  |  |  |  |  |  |  |  |  |  |  |  |  |

*These are totals of risked developable resource estimates and not the sum of the conditional estimates in the columns above. See Section IV.A.1. for a discussion regarding aggregation of resource estimates.

be present in these planning areas one year earlier than under Alternative I. However, the presale planning process for each sale would not be abridged. The full presale planning process, including all opportunities for consultation with affected parties would be conducted. Therefore, it is unlikely that the ability of State and local governments to comment during the sale process or to do adequate planning for the potential sale and subsequent activities would be adversely affected. Potential impacts of this alternative are expected to be essentialy the same as for Alternative I.

### 6. Alternative VI - Defer Leasing in Six Planning Areas

#### a. Description of the Alternative

This alternative evaluates the deferral from leasing during this 5-year program of six whole planning areas: North Atlantic; Southern, Central, and Northern California; Washington-Oregon; and North Aleutian Basin. The leasing schedule for other planning areas is assumed to remain the same as in Alternative I. The analysis in this alternative evaluates the potential environmental effects of a 5-year program which does not include leasing in these six planning areas for which requests for deferral were made in various comments on the Draft Proposed Program. The resource estimates and exploration and development assumptions for the remaining planning areas would remain the same as for Alternative I as would the number and timing of sales in the remaining planning areas. Under this alternative, there would be 28 sales scheduled for the 5-year program. See Table II.A.6.

#### b. Summary of Impacts

Under this alternative for these six planning areas, potential impacts which would result from exploration, development, and productions activities on all components of the physical, biological, and socioeconomic environment would be avoided. The impacts on all other planning areas are expected to be the same as for Alternative I-the Proposed Action.

### 7. Alternative VII - No Action

#### a. Description of the Alternative

The Secretary is required by section 18(a) of the OCSLA to maintain an oil and gas leasing program to implement the policies of that Act. The evaluation of a "no action" alternative is required, however, by the regulations implementing NEPA (40 CFR 1502.14(d)). It is assumed for this alternative that the Secretary takes no action to implement a new 5-year program, and, therefore, that no oil and gas leasing would occur for the indefinite future.

If a new 5-year OCS oil and gas leasing program is not implemented, future production from the OCS would be reduced. A reduction in OCS hydrocarbon input into the national energy reserves would necessitate a commensurate replacement of energy from other sources or a decrease in demand.

Table II.A.6
Conditional oil and gas resources and infrastructure for Alternative 6
Defer Leasing in Six Planning Areas

| Planning Area | No. Sales | Conditional Resources Oil (Million bbls) | Conditional Resources Gas (BCF) | Conditional Resources Million BOE | Marginal Probability of Commercial Hydrocarbons | No. Exploratory and Delineation Wells | No. Development/ Production Wells | No. Platforms | Delineation Wells First Year | Delineation Wells Last Year | Delineation Wells Period of most intense activity | Platforms First Year | Platforms Last Year | Platforms Period of most intense activity | Production Wells First Year | Production Wells Last Year | Production Wells Period of most intense activity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mid-Atlantic | 1 | 25 | 419 | 100 | 1.00 | 9 | 11 | 1 | 1991 | 1993 | 1991-93 | 1996 | 1996 | 1996 | 1997 | 1998 | 1997 |
| S. Atlantic | 1 | 69 | 1294 | 299 | 0.25 | 11 | 35 | 1 | 1991 | 1993 | 1992-93 | 1996 | 1996 | 1996 | 1997 | 1999 | 1997-8 |
| W. GOM | 5 | 437 | 6155 | 1532 | 1.00 | 713 | 912 | 76 | 1988 | 2000 | 1992-96 | 1992 | 2005 | 1995-98 | 1992 | 2006 | 1996-98 |
| C. GOM | 5 | 1004 | 8286 | 2479 | 1.00 | 1246 | 1596 | 133 | 1988 | 2001 | 1992-97 | 1992 | 2005 | 1996-99 | 1992 | 2006 | 1997-99 |
| E. GOM | 2 | 62 | 329 | 120 | 1.00 | 19 | 36 | 2 | 1990 | 1995 | 1990-94 | 1995 | 1998 | 1995,1998 | 1996 | 2001 | 1996-2000 |
| Gulf of Alaska | 1 | 113 | 1751 | 425 | 0.08 | 12 | 42 | 1 | 1990 | 1994 | 1990-91 | 1998 | 1998 | 1998 | 1998 | 2002 | 1998-2001 |
| Kodiak | 1 | 95 | 1840 | 422 | 0.05 | 12 | 42 | 1 | 1993 | 1998 | 1993 | 2001 | 2001 | 2001 | 2002 | 2007 | 2002-06 |
| Cook Inlet | 1 | 179 | 298 | 231 | 0.03 | 10 | 23 | 1 | 1993 | 1997 | 1993 | 2000 | 2000 | 2000 | 2001 | 2003 | 2001-02 |
| Shumagin | 2 | 48 | 1363 | 291 | 0.03 | 9 | 30 | 1 | 1992 | 1996 | 1992-93 | 1999 | 1999 | 1999 | 2000 | 2003 | 2000-02 |
| St. George | 1 | 135 | 1261 | 369 | 0.22 | 11 | 35 | 1 | 1991 | 1994 | 1991-93 | 1998 | 1998 | 1998 | 1999 | 2003 | 1999-2002 |
| Navarin | 2 | 1920 | 2336 | 2336 | 0.27 | 82 | 229 | 7 | 1989 | 1994 | 1991-93 | 1998 | 2002 | 1998-2000 | 1998 | 2006 | 2001 |
| Norton | 1 | 102 | 470 | 186 | 0.15 | 10 | 18 | 1 | 1991 | 1994 | 1991-93 | 1998 | 1998 | 1998 | 1999 | 2003 | 1999-2002 |
| Hope | 1 | 145 | 1539 | 418 | 0.02 | 13 | 40 | 1 | 1993 | 1997 | 1993-96 | 2001 | 2001 | 2001 | 2002 | 2006 | 2002-06 |
| Chukchi Sea | 2 | 1152 |  | 1152 | 0.20 | 37 | 105 | 3 | 1989 | 1995 | 1991-92 | 1997 | 1999 | 1997-99 | 1998 | 2004 | 2000-01 |
| Beaufort | 2 | 627 |  | 627 | 0.70 | 22 | 61 | 2 | 1989 | 1994 | 1991 | 1998 | 1998 | 1998 | 1999 | 2002 | 1999-2001 |
|  | 28 | 2800* | 16,778* | 5786* |  |  |  |  |  |  |  |  |  |  |  |  |  |

These are totals of risked developable resource estimates and not the sum of the conditional estimates in the columns above.
See Section IV.A.I. for a discussion of aggregation of resource estimates.

### b. Summary of Impacts

It is unlikely that only one energy source or action would be employed to make up the energy shortfall caused by cancelling the proposed sale. Instead, a combination of some or all of the alternates seems likely. The future U.S. energy source mix well depends on a multiplicity of factors, among them the identification of resources, research and development efforts, development of technology, rate or economic growth, the economic climate, changes in lifestyle and priorities, capital investment decisions, energy prices, world oil prices, environmental quality priorities, government policies, and availability of imports. The most likely combination of alternates, given the factors just stated, appears to be a greater reliance on imported oil and natural gas, domestically produced strip-mined coal, and conservation resulting from increased prices and capital substitution.

Table II.A.7. briefly presents the environmental concerns and economic obstacles associated with alternative energy sources. Appendix C of this EIS contains further discussion of alternative energy sources.

Table II.A.7. Alternative Energy Sources or Actions and Their Possible Impacts or Obstacles to Implementation

| Source or Action | Impact or Obstacle |
|---|---|
| Imports (Oil and Gas) | - increased reliance on foreign sources<br>- adverse effects on trade balance<br>- increased risk of oil spills from tankers |
| Energy Conservation | - increased consumer cost<br>- large capital investment |
| Coal | - disruption of land<br>- emissions of $SO_2$ and particulates<br>- water pollution (surface and ground)<br>- increased noise<br>- large amount of water needed for gasification |
| Nuclear Fission | - release of small amount of radioactive material and heat<br>- high cost and public concern limiting construction of new plants<br>- no suitable waste disposal solution |
| Nuclear Fusion | - technologically not possible at present or in the near future |
| Tar Sands | - modification of surface topography<br>- water pollution |

Table II.A.7. (continued

| Source of Action | Impact or Obstacle |
|---|---|
| | - dust and vehicle emissions<br>- increased noise level<br>- disposal of residual material<br>- cost not presently competitive |
| Oil Shale | - disposal of spent shale<br>- disruption of land<br>- dust and vehicle emissions<br>- large quantities of water needed in processing<br>- cost not presently competitive |
| Solar | - high initial or fixed cost unattractive to individual homeowner given other alternatives<br>- commercial use not technologically possible at present |
| Hydroelectric | - irreversible commitment of land resources<br>- elimination of wildlife habitats<br>- high initial cost<br>- loss of free-flowing river recreation<br>- most favorable sites already in use |
| Domestic non-OCS Oil | - little prospect of large deposits |

Note: Detailed information on these and other energy sources and their environmental impacts can be found in: Energy Alternatives: A Comparative Analysis (University of Oklahoma, 1975), prepared for the Bureau of Land Management by the Science and Public Policy Program of the University of Oklahoma. See also Appendix C of this EIS.

Source: FEIS, 1982, St. George Basin, Minerals Management Service--Alaska OCS Region.

Selection of the no action alternative would eliminate potential environmental impacts associated with the proposed action. Changes to the physical, biological, and socioeconomic environment will still occur without the proposal. Existing oil and gas activities from previous OCS sales and oil and gas development in State waters, as well as importation of oil and gas via tankers, will continue. Impacts associated with other non-OCS projects which are ongoing or are planned will cause changes to the environment as well. Several of these activities are described in Section IV.B. for each planning area.

## B. Comparison of Alternatives

### 1. Atlantic Region

Alternative I includes four sales in the Atlantic OCS. The North Atlantic Planning Area will have two sales (1988 and 1991, respectively). The Mid- and South Atlantic Planning Areas will each have one sale in 1989.

Four sales in the Atlantic Region are also scheduled for Alternatives II and V. Scheduling of the sales will remain the same for Alternative III, but a 1991 sale would be added in the southern portion of the Straits of Florida planning area. Under Alternative IV, there will be a sale in the North, Mid-, and South Atlantic Planning Areas in 1988 and in 1990. Alternative V has four sales scheduled, but the timing is changed so the North Atlantic Planning Area has sales in 1988 and 1990, respectively. The Mid- and South Atlantic Planning Areas each have one sale in 1988 under Alternative V. In the case of Alternative VI, sales in the North Atlantic Planning Area are deleted, and the Mid- and South Atlantic Planning Areas each have one sale in 1989.

No sales would occur under Alternative VII.

The exact amount of acreage which may be leased under each alternative cannot be accurately predicted. Relatively speaking, however, Alternatives I and V could be expected to result in similar amounts leased. Less acreage would be expected to be leased under Alternative II as some promising locations might be in deferred subareas. Alternative III with one, and Alternative IV, with two more sales scheduled than Alternatives I and V, would be expected to result in more acreage leased. No new acreage would be leased in the North Atlantic under Alternative VI, and no new acreage would be leased on the entire Atlantic OCS under Alternative VII.

The estimated number of oil spills greater than 1,000 barrels and the probability of one or more such spills occurring for Alternative I are listed in Table IV.A.4.a.1. These values remain the same or do not change significantly for Alternatives II, IV, and V. Under Alternatives III, one spill is added because of the addition of a sale in the Straits of Florida. No spills would be expected in the North Atlantic Planning Area under Alternative VI, nor are spills expected on the entire Atlantic OCS under Alternative VII, expect for those that are caused by other activities.

Environmental Impacts: A generalized comparison of expected environmental impact levels is presented in Table II.B.1. This table summarizes impacts discussed in Chapter IV for Alternative I. A listing of the definitions of the impact levels for each resource is included in Appendix A.

Basically, Alternatives I, III, IV, and V will have very similar impacts. Alternative II will have less impacts in specific subareas than those four, while Alternatives VI and VII will result in no additional impacts in the Atlantic OCS. Important differences in the other alternatives' environmental impacts are discussed below.

TABLE II.B.1. --SUMMARY OF IMPACT LEVELS

| RESOURCES | PLANNING AREAS | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NAT | MAT | SAT | WGM | CGM | EGM | W/O | NCA | CCA | SCA | GOA | KOD | COK | SHU | NAL | ST.G | NAV | NOR | HOP | CHU | BEU |
| WATER QUALITY | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L | L |
| AIR QUALITY | L | VL | VL | L | L | L | L | L | L | L-M | L | L | L | L | L | L | VL | L | L | L | L |
| INTERTIDAL BENTHOS | L | L | L | NA | NA | NA | VL | VL | VL | VL | L-M | L-M | L | L-M | VL-L | VL | VL | L | L | L | L-M |
| SUBTIDAL BENTHOS | L | L | M | L | L | VL | VL | VL | L | VL | L-M | L-M | L | L-M | VL-L | VL | VL | L | L | L | L-M |
| PLANKTON | L | L | L | VL | VL | VL | VL | VL | VL | VL | L-M | L-M | L | L-M | VL-L | VL | VL | L | L | L | L-M |
| FISH RESOURCES | M | L | L | M | M | M | VL | L | L | L | VL-M | L-M | L-M | L-M | L-H2 | VL | L | L-M | L | L | L-M |
| MARINE MAMMALS | VL | VL | L | L | L | L | VL | L | L | L-M | VL-M | VL-M | VL-M | VL-M | VL-M | L-M | L | L | L | L | VL-L |
| COASTAL/MARINE BIRDS | VL | VL | L | M | M | L | L | L | L | L | M | M-H | M-H | M-H | M-H | L-H | L | M | L | M | M |
| ENDANGERED/THREATENED SPECIES | X7 | VL | X8 | M | M | L | L | L | L | M | VL-L | VL-L | VL | VL-L | VL-L | VL-L | L-M | L | L | L | L-M |
| ESTUARIES AND WETLANDS | VL | VL | VL | M/L9 | H/M9 | L | L | L | L | L | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| AREAS OF SPECIAL CONCERN | M | VL | VL | VH | VH | VH | VL | VL | VL | L | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| MARINE SANCTUARIES | M | VL | L | VH | NA | NA | NA | NA | VL-L | L | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

TABLE II.B.1. SUMMARY OF IMPACT LEVELS - CONTINUED

| RESOURCES | PLANNING AREAS | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NAT | MAT | SAT | WGM | CGM | EGM | W/O | NCA | CCA | SCA | GOA | KOD | COK | SHU | NAL | ST.G | NAV | NOR | HOP | CHU | BEU |
| EMPLOYMENT AND DEMOGRAPHIC CONDITIONS | VL | VL | VL | VL | VL | VL | VL | L | VL | L | L-M | L | L | L-M | VL-L | M | M | M | L | L | L |
| COASTAL LAND USES/ WATER SERVICES-SUPPLY | M | M | M | VL-L | VL | VL-L | VL | VL | L | M-H | L | M | L | L | M | L-M | L | L | M | M | L |
| COMMERCIAL FISHERIES | VL | L | L | M | M | M | VL | L | VL | L | L | L | L | L | L-H2 | VL | VL | L | VL | NA | L |
| RECREATION/TOURISM | VL | VL | VL | L | L | VL | VL | VL | VL | L | L | L | L | VL | L | VL | VL | L | VL | L | VL |
| ARCHAEOLOGICAL | L | L | VL | L | L | L | VL | VL | VL | L | L | L | L | L | L | L | VL | L | L | VL | L |
| SUBSISTENCE USE PATTERNS | NA | NA | NA | NA | NA | NA | VL | VL | VL | VL | L | L | L | L | L | L-H | H | L-M | L | M | M |
| SOCIO-CULTURAL RESOURCES | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | L | VL | L | VL | L | VL-M | L | L | VL | M | L |
| MARINE VESSEL TRAFFIC, PORTS, AND OFFSHORE INFRASTRUCTURE | VL | VL | VL | VL | L | VL | VL | VL | VL | M | L | L | L | L | H | M | M | L | L | H | M |
| MILITARY USES | VL | L | VL | L | L | L | VL | VL | VL | L-M | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA |

1RIGHT WHALES
2RED KING CRABS

7VL-H1
8L-VH1
9SEA GRASSES

Alternative IV, biennial leasing, will result in six sales rather than four in the Atlantic OCS without significantly increased impacts. The projected oil spill risk increases with this alternative, but not significantly.

Alternative V, accelerated leasing, would still leave four sales. No increases in hydrocarbon resources and in environmental imapcts are expected when compared to Alternative I.

Alternative II, subarea deferrals, is expected to result in lower impact levels to some resources, as large areas have been identified for deferral. Impacts on a local level will be avoided or reduced; impacts on a regional level are not expected to be substantially reduced.

## 2. Gulf of Mexico

Alternative I includes twelve sales in the Gulf of Mexico OCS. The Western and Central Planning Areas will have five sales each (1987, 1988, 1989, 1990, and 1991, respectively). The Eastern Planning Area will have two sales (1988 and 1991).

Twelve sales are also scheduled for Alternatives II, III, V, and VI. Scheduling of the sales will remain the same for Alternatives II, III, and VI. Under Alternative IV, a sale would be added in the Eastern Gulf of Mexico. The sales would be held in 1987, 1989, and 1991. Under Alternative V, no new sales would be added in the Eastern Gulf, but the 2 sales scheduled there would be held in 1987 and 1989.

No sales would be occur under Alternative VII.

The exact amount of acreage which may be leased under each alternative cannot be accurately predicted. Relatively speaking, however, Alternatives I, III, V, and VI are expected to result in similar amounts leased. Less acreage is expected to be leased under Alternative II as some promising locations might be in deferred subareas. Alternative IV, with one more sale scheduled than Alternatives I, II, III, and V, is expected to result in more acreage leased. No new acreage would be leased under Alternative VII.

The estimated number of oil spills greater than 1,000 barrels and the probability of one or more such spills occurring for Alternative I are listed in Table IV.A.4.a.4. These values remain the same, or do not change significantly for Alternatives III, IV, V, and VI. Fewer spills and a reduced probability are expected for Alternative II. No spills are expected from Alternative VII, expect for those resulting from other activities, including existing OCS activities and import tankering.

Environmental Impacts: A generalized comparison of expected environmental impact levels is presented in Table II.B.1. This table summarizes impacts discussed in Chapter IV for Alternative I. A listing of the definitions of the impact levels for each resource is include in Appendix A.

Alternatives I, III, IV, V, and VI will have very similar impacts. Alternative II will have less impacts than those five, while Alternative

VII will result in no additional impacts in the Gulf of Mexico OCS. Important differences in the other alternatives' environmental impacts are discussed below.

Alternative II, subsea deferrals, is expected to result in lower impact levels to specific resources as two subareas would be deferred from leasing, the Florida West Coast Nearshore Block Deferral and the Miami Map area.

Alternative III, adding a sale in the Straits of Florida, would not significantly change the impacts to the Gulf of Mexico OCS as discussed under Alternative I.

Alternative IV, biennial leasing (Table II.B.4), will result in 13 sales rather than 12 in the Gulf of Mexico OCS, and slightly increased impacts to some resources in the Eastern Planning Area. The projected oil spill risk slightly increases with this alternative, but not significantly.

Alternative V, accelerated leasing, will still have 12 sales, but the proposed 1988 Eastern Gulf sale will be scheduled for 1987, and the 1991 Eastern Gulf sale will be held in 1989. The differences in scheduling are not expected to significantly change expected impact levels since the same presale planning process would still be conducted for each sale.

### 3. Pacific Region

Alternative I includes six sales in the Pacific OCS. The Washington/Oregon and Central California planning units will have one sale each (1991 and 1989, respectively). The Southern and Northern California planning units will each have two sales (Southern California in 1987 and 1990 and Northern California in 1988 and 1991).

Six sales are also scheduled for Alternatives II, III, and V. Scheduling of the sales will remain the same for Alternatives II and III. Under Alternative V, the Northern California sales will be held in 1988 and 1990, the Central California sale would also be held in 1988, and the Southern California sales would be held in 1987 and 1989. The timing of the Washington/Oregon sale would not change.

Under Alternative IV, eight sales are scheduled. In addition to the sales for Alternative I, a second sale would be added to Central California (1990), and the 1989 sale would be moved to 1988. Three sales would occur in the Southern California (1987, 1989, and 1991).

No sales would occur under Alternatives VI or VII.

The exact amount of acreage which may be leased under each alternative cannot be accurately predicted. Relatively speaking, however, Alternatives I, II, III, and V are expected to result in similar amounts leased. Alternative IV, with two more sales scheduled than Alteratives I, III, and V, is expected to result in more acreage leased. No new acreage would be leased under Alternatives VI and VII.

The estimated number of oil spills greater than 1,000 barrels and the probability of one or more such spills occurring for Alternative I are listed in Table IV.A.4.a.4. These values remain the same or do not change significantly (Central and Southern California: Alternative IV and Southern California: Alternative V) for Alternatives II, III, IV, and V. No spills are expected from Alternatives VI and VII, expect for those resulting from other activities, including existing OCS oil and gas activities.

Environmental Impacts: A generalized comparison of expected environmental impact levels is presented in Table II.B.1. This table summarizes impacts discussed in Chapter IV for Alternative I. A listing of the definitions of the impact levels for each resource is included in Appendix A.

Basically, Alternatives I, III, IV, and V will have very similar impacts. Alternative II will have less impacts than those four, while Alternatives VI and VII will result in no additional impacts in the Pacific OCS. Important differences in the other alternatives' environmental impacts are discussed below.

Alternative III, adding a sale in the Straits of Florida, will have exactly the same impacts to the Pacific OCS as Alternative I, as discussed in Chapter IV.

Alternative IV, biennial leasing, will result in eight sales rather than six in the Pacific OCS and increased impacts to certain resources. The projected oil spill risk increases with this alternative, but not significantly. Increased OCS activity is most likely to impact air quality, employment and demographics, land use, commercial fisheries, marine vessel traffic, and military uses.

Alternative V, accelerated leasing, will still have six sales, but the proposed 1990 Southern California sales will be scheduled for 1989; the 1989 Central California sale will be held in 1988; and the two Northern California sales will each be moved back 1 year, to 1988 and 1990. The net result in the Pacific Region would be one sale per year from 1987 through 1991, with two sales in 1988. (Under Alternative I, two sales each are scheduled for 1987 and 1989, one each for 1990 and 1991, and one in 1988). Resource estimates decrease under this alternative, but this change and the change in oil spill risk are not considered large enough to significantly change potential impact levels. The differences in scheduling are not expected to cause changes in potential impacts.

### 4. Alaska Region

Alternative I includes 15 sales in the Alaska OCS. The Gulf of Alaska, Kodiak, Cook Inlet, North Aleutian Basin, St. George Basin, Norton Basin, and Hope Basin Planning Areas will have one sale each. Shumagin, Navarin Basin, Chukchi Sea, and Beaufort Sea Planning Areas will each have two sales.

Fifteen sales are also scheduled for Alternatives II, III, and V. Scheduling of the sales will remain the same for Alternatives II and III.

Under Alternative V, the Beaufort Sea, Chukchi Sea, and Navarin Basin sales will be held in 1987 and 1989; the Norton Basin, North Aleutian Basin, St. George Basin, and Shumagin sales will be held in 1988; and a frontier exploration sale would be held in each of the following planning areas: Gulf of Alaska, Kodiak, Cook Inlet, Shumagin, and Hope Basin.

Under Alternative IV, 21 sales are scheduled. In addition to the sales for Alternative I, an additional sale would be added to Beaufort Sea, Chukchi Sea, Norton Basin, Navarin Basin, St. George Basin, and North Aleutian Basin.

Under Alternative VI, no sale would be held in the North Aleutian Basin.

No sales would occur under Alternative VII.

The exact amount of acreage which may be leased under each alternative cannot be accurately predicted. Relatively speaking, however, Alternatives I, III, and V are expected to result in similar amounts leased. Less acreage is expected to be leased under Alternative II as some promising locations might be in deferred subareas. Alternative IV, with six more sales scheduled than Alternatives I, III, V, is expected to result in more acreage leased. No new acreage would be leased under Alternative VII.

The estimated number of oil spills greater than 1,000 barrels and the probability of one or more such spills occurring for Alternative I are listed in Table IV.A.4.a.4. These values remain the same for Alternative V and do not change significantly for Alternative IV except for the St. George Basin planning area which may have two spills rather than one over the life of the proposal. Alternative III will not affect Alaskan activities. Alternative VI will remove the threat of oil spills from production which would have occurred within the North Aleutian Planning Area but will have no effect on other Alaskan planning areas. Fewer spills and a reduced probability are expected for Alternative II although the potential decreases are unquantified at this time. No spills are expected from Alternative VII except for those resulting from other activities such as tankering of Canadian Oil or existing OCS activities.

Environmental Impacts: A generalized comparison of expected environmental impact levels is presented in Table II.B.1. This table summarizes impacts discussed in Chapter IV for Alternative I. A listing of the definitions of the impact levels for each resource is included in Appendix A.

Alternatives I, III, IV, V, and VI, will have very similar or slightly higher (Alternative IV) impacts. Alternative II will have less impacts due to deferral of the Point Barrow and Unimak Pass subareas, while Alternative VII would result in no additional impacts in the Alaskan OCS. Alternative VI would preclude impacts from this program from occurring within the North Aleutian Planning Area. Important differences in the other alternatives' environmental impacts are discussed below.

Alternative III, adding a sale in the Straits of Florida, will have the same impacts to the Alaska OCS as Alternative I, as discussed in Chapter IV.

Alternative IV, biennial leasing, will result in 21 sales rather than 15 in the Alaskan OCS, and increased impacts to certain resources. There is no increase in resources for the five frontier areas. Increases in oil and gas resources for the North Aleutian, Norton, and Beaufort Planning Areas are not large enough to significantly increase impact levels. In the St. George, Navarin and Chukchi Planning Areas, resource estimates will increase projected oil spill risks. Increased OCS activity is most likely to impact some biological resources and employment and demographics, commercial fisheries, marine vessel traffic.

Alternative V, accelerated leasing, will still have 15 sales, but the sales would be at a faster pace than in Alternative I. However, the presale planning process for each sale would not be foreshortened.

Alternative II, subarea deferrals, is expected to result in lower impact levels to most resources within the subareas which would be deferred (the subareas north of Unimak Pass and Point Barrow). Overall, resources not expected to have changed impacts are air and water quality, plankton, employment and demographics, land use and water supply, cultural resources, and native subsistence cultures.

# III. AFFECTED ENVIRONMENT

## A. Atlantic Region

### 1. North Atlantic

### a. Physical Environment

### (1) Geology

The North Atlantic Continental Shelf, Slope and Rise are structurally dominated by the Georges Bank Basin, a structural depression in the crystalline basement rock. It is approximately 280 km (174 miles) long and 150 km (93 miles) wide. The Basin was formed at roughly the same geologic time and under similar stresses as the Baltimore Canyon Trough. Geologists believe that during the initial opening of the Atlantic Ocean, either during the Permian or Triassic, opposing rotations of the American plate and African plate created tensional forces, resulting in the formation of large fault blocks in what is now considered basement rock of the Basin. As a result of extensive erosion and transport of onshore components, the Basin was filled with large amounts of sand, gravel, and clay, resulting in further subsidence.

Four major depositional sequences have been delineated in the Georges Bank Basin by means of acoustic surveys: (1) Triassic (?) and Lower Jurassic non-marine clastic rocks and evaporite deposits; (2) non-marine clastic rocks and marine carbonates of Middle and Upper Jurassic age; (3) Cretaceous marine and non-marine clastic sedimentary rocks; and (4) Cenozoic marine and glacial sediments.

The most attractive exploration target in the North Atlantic Basin is the Jurassic shelf-edge reef trend which underlies the continental slope. Traps associated with this trend are back-reef anticlines, stratigraphic pinchouts, and faulted anticlines and noses.

### (2) Geologic Hazards

Hazards that have been noted in the North Atlantic are shallow gas, shallow faults, and sediment mass movement. Shallow gas occurs on the continental slope and shelf; shallow faults have only been reported to occur on the continental shelf. Neither shallow gas nor shallow faulting are major sources of concern as they rarely occur in the North Atlantic. The major hazard found here is sediment mass movement, which is found on the continental slope and upper rise. Canyons seem especially susceptible to mass movement; here the tidal currents are concentrated, undercutting the canyon walls, which weakens the sediment layers to the point where they slump, slide, or collapse into debris flows. Intercanyon areas appear generally free from sediment mass movement with the exceptions of the slope in the vicinity of Alvin and Atlantis Canyons and the vicinity of Munsen and Nygren Canyons. Sediment movement in the form of slides also appears to be common on the mid and lower slope intercanyon areas. The innercanyon mass movement is considered to be a contemporary process. Most authors seem to feel that because there is no known present-day triggering mechanism, the intercanyon mass movement probably originated during Pleistocene glacial retreats, when large volumes of water and sediment were debouched onto the continental slope. Buried channels, deep faulting, and erosion are the known constraints to drilling in the North Atlantic. These are more widespread in occurrence than the hazards. Buried channels occur on the shelf and slope, deep faults occur throughout the North Atlantic, and erosion occurs mostly on Nantucket Shoals, Georges Bank, and possibly along the continental rise. No data exists to confirm erosion on the continental rise but high-velocity currents have been recorded on the rise south of Nova Scotia.

### (3) Non-Petroleum Mineral Resources

The major non-energy minerals in the north Atlantic are sand, gravel, and placer deposits of heavy minerals (e.g. gold, platinum, ilmenite, staurolite, rutile, etc.). One of the dominant sources of sand and gravel is the glacial deposits created by the series of glaciers that scraped through the area, leaving behind poorly sorted deposits of fine to coarse aggregate. Sand can be found in many areas where waves or paleo-rivers winnowed the fine materials out, leaving behind the sands. These winnowed deposits are also prime sites to find heavy minerals. The same forces which concentrate the sands also tend to concentrate the heavy minerals.

Presently there is no offshore mining in the north Atlantic, however, as the populated areas deplete their onshore sources of building aggregate, the continental shelf will become a major supplier. The association of heavy minerals with sand and gravel deposits enhances the value as two resources can be exploited essentially for the price of one. Tight supplies of titanium and platinum in addition to the increasing need for sand and gravel could mean offshore mining not too many years in the future.

### (4) Oceanography

#### (a) Chemical

The primary north Atlantic area water masses include the continental shelf water (within which the Georges Bank is located) and slope water, and to a smaller degree, the Gulf Stream. Water temperature in the area reflects a general seasonal pattern of vertical water column stratification during summer/early fall and a relatively homogenous mixing at other times (Colton and Stoddard, 1972). However, in shallow areas such as the Georges Bank and Nantucket Shoals, strong vertical thermal stratification is limited due to tidal mixing. Surface salinity does not show a similar seasonal distribution pattern as does temperature (Pawlowski and Wright, 1978). A relatively large homogeneous salinity field over the Georges Bank and the Gulf of Maine area is bounded by sharp gradients to the east (at Scotian Shelf break) and the south (at shelf-slope front).

Annual dissolved oxygen saturation in the area has been reported in excess of 90 percent and 50 percent for surface and deeper waters (100 to 200 meters), respectively (Colton et al., 1968). Maximum phosphate concentrations occur in winter due to vertical mixing, and minimum concentrations are found in the summer, attribututable to phytoplankton uptake during time of decreased vertical mixing (Riley, 1941). Nitrate concentrations increase with depth at all times of the year.

### (b) Physical

The North, Mid-, and South Atlantic Planning Areas share, in general, similar oceanographic and meteorological characteristics. However, enough distinctions exist that they can be treated separately. Overall, there are two water masses in each of the areas: shelf and deep-ocean waters, with a transition zone between them that is very distinctive in the mid-Atlantic and practically nonexistent in the South Atlantic Planning Area.

Common to the north and mid-Atlantic are the canyons that incise the shelf-slope region and the "cold band." The latter is of concern because it is believed to have a very restricted mass exchange with surrounding waters which may lead to potential concentration and transport of pollutants.

The region's circulation is quite complex. The Gulf of Maine's waters flow in a counterclockwise direction at about 5 cm/s (EG&G, 1982), whereas that of the Georges Bank consists of a seasonally dependent gyre-like clockwise flow around the shallow area atop the Bank. The circulation over this shallow area is weak on the horizontal plane but quite energetic on the vertical--mostly the result of wind, waves, and tide interaction with the shallows. A jetlike current marks the transition between the Gulf of Maine and the Georges Bank. South of the Bank, beyond the frontal zone and the slope waters, the Gulf Stream flows toward the open north Atlantic Ocean.

Disturbances of the Gulf Stream--meanders and eddies--have dramatic effects on the circulation of the Georges Bank. The Great South Channel and the Northeast Channel bound the Georges Bank area to the west and northeast, respectively. The circulation in these channels consists of inflows and outflows, depending on the location relative to the channels' axes. South of Nantucket Island, there is an active zone of sedimentation: Nantucket Shoals.

Wave heights and directions exhibit a seasonal pattern. During the winter, relatively large waves propagate from the west and the northwest. During the summer waves are smaller, propagating from the south or southwest.

Canyon circulation in the region is influenced by atmospheric, tidal, and seasonal characteristics, but in general consists of a downaxis flow to the vicinity of the 600-m depth contour. In deeper areas of the canyons, the flow is up the axis. This pattern suggests that upwelling events are of regular occurrence in canyon areas. A detailed description of the North Atlantic Planning Area is given in the FEIS for the April 1984 Sale (Sale No. 82).

Winds over the entire area are westerly with a slight clockwise rotation offshore. Of concern for offshore activities are the nor'easter storms that affect the region during the fall, winter, and spring. Although hurricanes are not unknown, nor'easters are of more concern because of the high waves that they can generate.

### (5) Water Quality

Water quality in the north Atlantic appears to be generally good, showing only very limited effects of man-made inputs. Studies conducted by ERCO (1978) and Boehm et al. (1979) have detected hydrocarbon compounds in the north Atlantic area. Dissolved and particulate hydrocarbons in the water column reflected chronic inputs from tanker, shipping and fishing vessel operations, and from the break-up of the tanker Argo Merchant in 1976. In the water column of Georges Bank and Nantucket Shoals, concentrations of the dissolved hydrocarbon fractions were generally 0.1 to 2.0 parts per billion (ppb) (10 ppb during the four months following the Argo Merchant spill); particulate hydrocarbon levels ranged from 0.01 to 5.31 ppb.

Hausknecht (1979) reported maximum values of total suspended matter on the Georges Bank at 0.96 mg/l; levels in the Gulf of Maine and slope water were lower (0.06 to 0.52 mg/l). Much of the particulate trace metal over the Georges Bank was found to be associated with organic matter, although originating from primarily from inorganic sources (ERCO, 1978). Particulate copper and lead showed some nearshore enrichment. Except for coastal disposal of dredged materials, which results in temporary degradration of local water quality, no other materials are presently being dumped in the North Atlantic Planning Area.

### (6) Ocean Dumping

Dredged materials are the only materials presently being dumped in the north Atlantic. Five active, dredged materials dumpsites are located nearshore (usually less than 5 nautical miles from shore) along the North Atlantic Coast (40 CFR 228.12, July 1, 1984) (Figure III.A.1.a.6-1). Most of these sites have an "approved interim" status, meaning that environmental studies for determining impact and continued use have not been completed by the U.S. Environmental Protection Agency. Two former, industrial waste dumpsites, off the coasts of Maine and Massachusetts, are no longer being used.

Also scattered throughout the north Atlantic area are former sites, presently inactive, used for dumping of undetonated explosives (e.g. bombs and depth charges)--4 major sites, and for dumping radioactive materials (by-product and source matter) encased usually in 4,008 steel drums--1 major site (U.S. EPA, 1980; NRC, 1981; Smith and Brown, 1971; 1982 NOAA Navigational Chart 13003). Locations of the undetonated explosives and radioactive materials dumpsites are only approximately known because of incomplete records.

### (7) Climate

In the North Atlantic Planning Area, westerly and northwesterly winds pre-

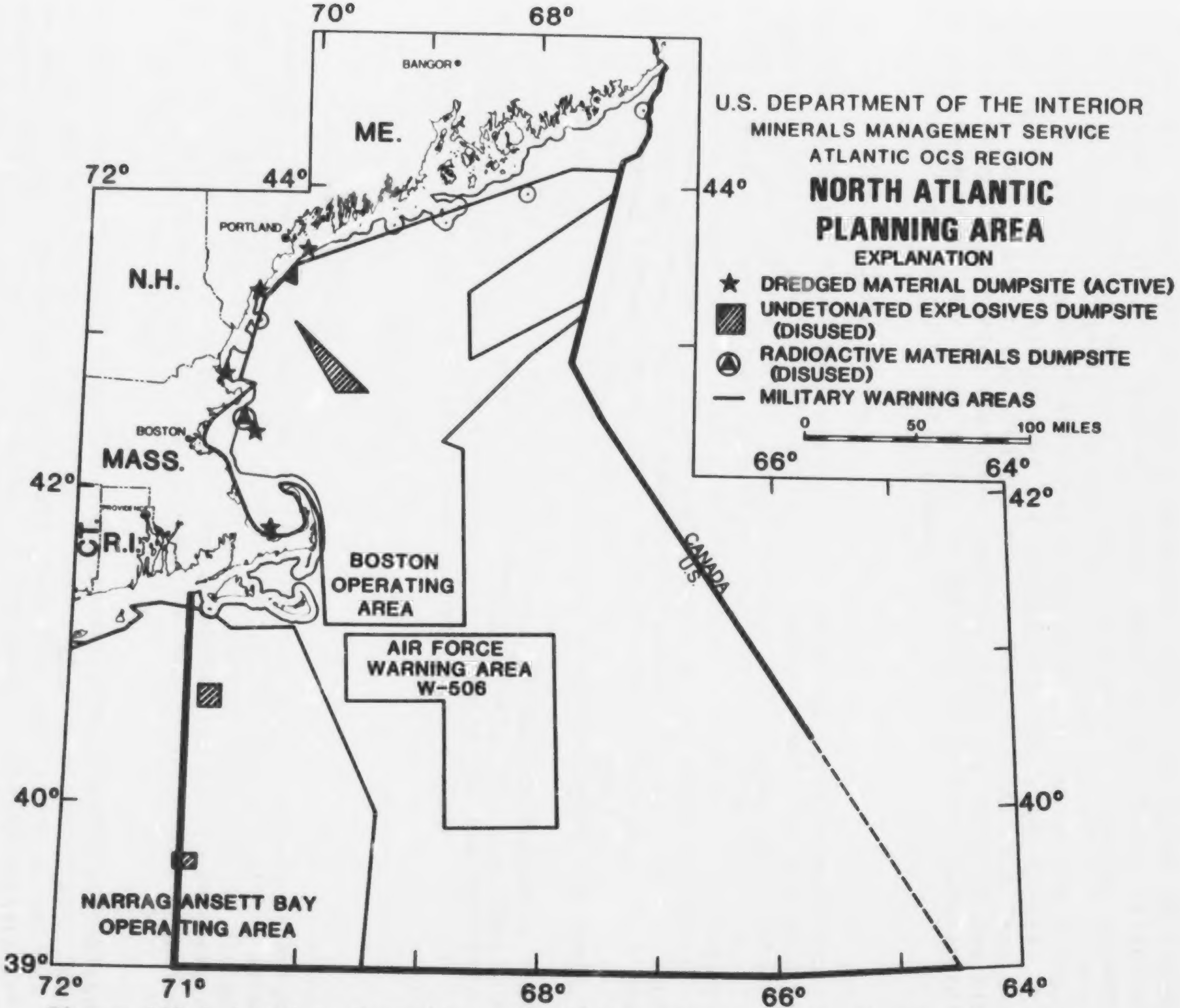

U.S. DEPARTMENT OF THE INTERIOR
MINERALS MANAGEMENT SERVICE
ATLANTIC OCS REGION
NORTH ATLANTIC PLANNING AREA
EXPLANATION
★ DREDGED MATERIAL DUMPSITE (ACTIVE)
▨ UNDETONATED EXPLOSIVES DUMPSITE (DISUSED)
RADIOACTIVE MATERIALS DUMPSITE (DISUSED)
— MILITARY WARNING AREAS
0
50
100 MILES
BANGOR
ME.
PORTLAND
N.H.
BOSTON
MASS.
R.I.
CT.
BOSTON OPERATING AREA
AIR FORCE WARNING AREA W-506
NARRAGANSETT BAY OPERATING AREA
CANADA
U.S.
72°
70°
68°
66°
64°
71°
44°
42°
40°
39°

Figure III.A.1.a.6-1. Dumpsites and Military Areas in the North Atlantic Planning Area.

vail between the months of October and March, inclusive. The mean wind velocities during these months ranges from 7 to 12 knots and the higher velocities typically are found in the more seaward direction. During the remaining months a shift to southwesterly winds is usual, with mean monthly velocities between 3 and 6 knots.

During later summer and fall the area may be subject to storms of tropical or extratropical origin. Tropical storms (hurricanes, if wind velocity is greater than 63 knots) are usually more intense with wind speeds between 34 and approximately 115 knots. However, extratropical storms usually are accompanied by high precipitation and large waves because of the increased fetch (unrestricted distance over sea surface that the winds travel). Typically, the winds in the area are greater than 34 knots less than 14 percent of the time during the winter and less than 1 percent of the time during the summer. Air temperatures in the area range from approximately 4°C in the winter to 19°C in the summer.

### (8) Air Quality

The Environmental Protection Agency (EPA) has established primary and secondary National Ambient Air Quality Standards (NAAQS) for sulfur dioxide (SO2), nitrogen dioxide (NO2), carbon monixide (CO), ozone (O3), total suspended particulates (TSP), and lead (Pb). Primary standards are designed to protect public health, while the more restrictive secondary standards are intended to protect public welfare, including aesthetic values. The 1977 Clean Air Act Amendments require all areas of the country to be categorized according to their NAAQS attainment/non-attainment status for the specific pollutants. Also, States have been required to submit State Implemental Plans (SIPs) for attaining compliance with the NAAQS.

Within the State of Rhode Island the only area of non-attainment for TSP is the City of Providence. Within eastern Massachusetts, CO is currently non-attainment within several areas. Within the metropolitan New York City - New Jersey region CO and O3 are non-attainment in many areas.

## b. Biological Environment

### (1) Plankton

Planktonic organisms are defined as floating or weakly swimming organisms that cannot maintain their distribution against the movement of the water masses in which they live. The planktonic community basically is divided into two major trophic categories: phytoplankton--the autotrophic organisms which photosynthesize; and zooplankton--the heterotrophic organisms which feed on other plankton.

Marshall and Cohn (1982) described the seasonal phytoplankton assemblages offshore of New England. High concentrations of phytoplankton were found on Georges Bank, Nantucket Shoals, and along the shelf break as well as several nearshore stations. Diatoms are the dominant phytoplankters during most of the year; however, their relative importance varies with season. During the spring and fall blooms the larger diatoms predominated, while during the non-bloom periods small chainforming species dominated both nearshore and offshore.

The National Marine Fisheries Service (NMFS) Northeast Fisheries Center (NEFC) determined primary productivity levels in the north Atlantic using the 14C technique. From those data, Cohen and Wright (1979) calculated that the primary productivity of Georges Bank was 400 to 500 g C/sq.m./yr between 1975 and 1978. More recent data collected during the MARMAP and Ocean Pulse surveys (O'Reilly and Busch, 1984) indicated productivity levels of 470 g C/sq.m./yr in the shoal areas of the bank and approximately 300 g C/sq.m./yr in the deeper bank water before the shelf break.

Nannoplankton (<20 um) were found to dominate particulate production in 38 percent of the observations made on the top of Georges Bank, whereas it was more important in 87 percent of the observations in the deeper portions of the bank (O'Reilly and Busch, 1984). In the shallower area, large net-plankton, mostly diatoms, are major contributors to the measured primary production. These elevated levels of primary production are further reflected at higher trophic levels, which makes Georges Bank one of the most productive regions, per unit area, of any oceanic shelf region (O'Reilley _et al_., 1981). Cohen and Wright (1979) and Hopkins and Garfield (1981) concluded that the high productivity level of Georges Bank can be attributed to the unique topography and hydrography of Georges Bank. Vigorous tidal circulation and turbulence cause complete vertical mixing throughout the year on the shallow crest of the bank. This mixing prevents any stratification in the water column so there is no thermocline to restrict the upward flow of nutrients to the surface. The amount of sunlight is thus a critical factor in determining the primary productivity levels throughout the year. In winter, light levels are low and the critical depth above which photosynthesis exceeds respiration is shallow. Productivity is at a minimum at this time. In spring, insolation increases and the critical depth and photic zone deepen. The spring phytoplankton bloom begins when the critical depth reaches the bottom. It is not until late fall-winter when insolation decreases to the extent that the photic zone decreases, that production drops to winter minimums (Cohen and Wright, 1979; Hopkins and Garfield, 1981).

Diatoms are the dominant phytoplankton organisms in the Gulf of Maine, followed by dinoflagellates and coccolithophores. The densities of organisms demonstrate a bimodal seasonal distribution with a major spring peak and minor fall peak and a winter minimum. The primary productivity follows a similar pattern, with an annual production ranging from 100 to 200 g C/M2 Cohen, 1975).

Sherman and Jones (1980) found that _Calanus finmarchicus_ was dominant over Georges Bank in early spring, being succeeded in later summer and autumn by _Centropages typicus_. This generally agrees with the earlier findings of Riley and Bumpus (1946). TRIGOM (1974) summarized the distribution and life history characteristics of 24 of the most important species within the north Atlantic area.

Following the findings of Cohen and Wright (1979) and Hopkins and Garfield

(1981) on seasonal maxima of primary productivity zooplankton growth rates are enhanced during spring and summer. Higher trophic levels which rely on the primary and secondary productivity are aso able to experience increased growth potential. Observations on zooplankton abundance (Clark, 1940; Grice and Hart, 1962), benthos (Sanders *et al*., 1965), and fish stocks (Schroeder, 1955) show higher levels of standing stocks at the shelf-slope break region than on either side.

Enhanced secondary productivity may ultimately be reflected in the stocks of fish and whales. Several important commercial groundfish species are known to aggregate south and offshore of Georges Bank in deep water ( 100 meters) during late winter and spring spawning seasons (Bigelow and Schroeder, 1953; Grosslein and Bowman, 1973; Hare, 1977).

Highly productive areas of the Great South Channel also see concommitant feeding concentrations of humpback and right whales from late April to mid-June (CETAP, 1982). Right whales feed on patches of plankton whereas humpback whales feed on dense schools of fish which feed on the plankton (Watkins and Schevill, 1979). It also appears that these two species of migrating cetaceans may utilize deeper waters along the continental slope and possibly the Gulf Stream. CETAP (1982) data showed the greatest number of sightings of fin, sei, sperm, right, and humpback whales occurred during spring and summer concommitant with feeding or inferred feeding behavior.

The zooplankton community of the Gulf of Maine is dominated by *Calanus* sp., primarily *C. finmarchicus*, *pseudacalamus* and *Metridia lucens*. Seasonal increases of planktonic benthic larvae are evident, and the overall abundance and distribution of the zooplankton appears to be influenced by variations in the physical oceanography of the Gulf of Maine and Georges Bank.

### (2) Benthos

#### (a) Intertidal

The coastline of Maine, New Hampshire and northern Massachusetts is a high energy area composed predominantly of rocky headlands. The exposed rocky shore supports a dense and diverse assemblage of invertebrates which are an important food source for a variety of seabirds. Invertebrates are comprised of, but not limted to barnacles, cockels oysters, clams, periwinkles, and limpets. Flora such as *Fucus sp.* also occur in the intertidal area.

The lower coastline in the North Atlantic is comprised more of moderately populated (e.g., molluscs, bivalves), medium grain--sandy beaches and densely populated (e.g., polychaetes, molluscs, bivalves crustaceaus) muddy fine sand silt wetlands.

#### (b) Subtidal

The bulk of the Georges Bank fauna is comprised of four major taxonomic groups: Annelida, Crustacea, Mollusca, and Echinodermata (Wigley, 1961).

Wigley found that each major component had a distinct geographic density pattern. Crustacea were most prevalent along the western and south-eastern sections of Georges Bank whereas the mollusks were most abundant in the northeast, south-central, and western areas. Echinoderms were particularly numerous in the center of the bank and annelids were prevalent on the northeast, south-central, and western sections.

Nearly all of Georges Bank was shown to have benthic biomass levels $\geq$ 50 g/m3, a value considered high when compared to the world's oceans as a whole. Wigley (1961) observed that wet weight biomass and total number of individuals were highest in coarse sediments and lowest in fine. The highest biomass value recorded was on gravel and sandy gravel; sediments dominated by silt-clay supported the lowest biomass.

Taxon (1983) reported that Georges Bank sediments are predominated by poorly sorted, gravelly sands on top of the bank grading into fine to medium sands (1 to 5 percent silt-clay) on the southern flank. Continuing toward the south and to the west, sediments were seen to increase in silt-clay content, reaching maximum values in a historical depositional area south of Nantucket Island called the Mud Patch. Stations in the Gulf of Maine and Lydonia Canyon also had a high silt-clay content. Faunal densities and species richness showed similar trends, increasing with depth across the bank and from east to west. Organism densities ranged from 1,000 individuals/m2 on top of the bank to greater than 40,000 individuals/m2 in the Gulf of Maine. Densities at most stations ranged between 4,000 and 14,000 individuals/m2. Some evidence exists for a trend of increasing density and species richness from winter to summer at the shallower stations.

More than 600 species were present in the samples analyzed by Taxon (1983). A species list appears as Table 4 in that report. Conclusions reached on the basis of those data were that small polychaetous annelids and peracarid crustaceans dominated on, and near, Georges Bank, followed by somewhat lesser amounts of mollusks and echinoderms. Haustoriid amphipods were dominant on the shallower crest of Georges Bank with polychaetes and mollusks becoming more important as sampling moved across the bank into deeper water.

The smaller mesh screen (0.3 mm) used by Battelle (1983) more accurately quantified and characterized the benthic infaunal community of Georges Bank than did the larger screens used by previous investigators. Using 1 mm sieves, Wigley (1961, 1965, and 1968) estimated the average abundance of benthic macroepifauna and infauna to be 1,690 individuals/m2. Combined survey results of Taxon (1963) and Maurer and Leathem (1981) from the New England Environmental Benchmark Program showed an average density of 6,413 individuals/m2 for samples sieved through 0.5 mm screens. In contrast, infaunal densities at the primary site-specific stations of the Georges Bank Infaunal Monitoring Program averaged 25,000 individuals/m2 (Battelle, 1983).

Hecker et al., (1983) studied the abundance and distribution of epibenthic megafauna in Lydonia Canyon and on a portion of the Continental Slope 80 miles to the west. They found that the density of megafauna varies with depth for both the slope and canyon habitats. In most cases, densities in Lydonia Canyon were higher than at comparable slope depths. In 300 to 450 meters, faunal abundances are high; densities in the canyon being greater owing to high concentrations of the sea pen (Pennatula aculeata), a brittle star (Ophiura sp.), a soft coral (Eunephthya florida), and the quill worm (Hyalinoecia artifex).

Generally lower megafauna abundances were noted at both the canyon and sites between 500 and 1,500 meters than were seen at depths less than 500 meters. Again, the canyon area had higher densities than did the slope. Dense patches of corals, sponges, and shrimp living among the boulders and outcrops present in Lydonia Canyon cause this difference.

In water depths greater than 1,500 meters, megafaunal densities increase, but do not reach the levels seen in the shallower depths (<500 m). The main reason for this increase is the presence of large concentrations of the brittle star, Ophiumusium lymani. Brittle stars are nearly twice as abundant at similar depths in Lydonia Canyon than on the slope.

The slope is dominated by species that favor relatively flat areas of soft sediment. Such areas are less common in Lydonia Canyon where species adapted to living in an area of steep walls, boulders, and outcrops predominate.

Lamont-Doherty (1982) reported that the distribution of epifaunal feeding types was quite variable along the slope and in the canyons. This variability was particularly pronounced in the steep, shallower areas of Lydonia Canyon where these types were evident above 1,200 meters. However, below 1,500 meters, the epifaunal community was dominated by filter feeders. This reflected the scarcity of food substances in the water and the generally low-energy current regime.

The Center for Natural Areas (CNA, 1977) reported on studies performed in nearshore of the Gulf of Maine. They indicated that densities of organisms ranged from 284-9,742 individuals/m2 (1mm screen) and the dominant phyla were Arthropoda, Mollusca, Annelida, and Echinodermata which contained approximately 37, 26, 16, and 14 percent, respectively, of the captured individuals. CNA (1977) also reported on two studies (Rowe et al., 1975 a,b) which sampled two deeper basins in the Gulf of Maine. The density of the infauna ranged from 302-8,411 individuals/m2 (0.42mm screen). Annelida species were the dominant organisms with over 50 percent of the individuals comprised of four polychaete species; Paramphinome jeffreysii, Heteromastus filiformis, Ancistrosyllis groenlandica, and Ophelina abranchiatii. Rowe et al. (1975) also observed that the epibenthos density was approximately 4 individuals/m2 and that Pandalus spp. shrimp were the most common.

### (3) Fish Resources

Fish resources of the north Atlantic region represent a wide array of species that inhabit the extremely productive waters of the northwest Atlantic in an interrelated, complex manner. Within this region, Georges Bank is the prominent feature and represents one of the most productive offshore habitats in the world. Productivity is consistently high in this area as a result of the interaction of the physical oceanographic, topographic, and meteorologic conditions that occur.

The FEIS for Sale No. 82 profiles many of the fish and shellfish found in the north Atlantic with respect to distribution, feeding preference, and spawning characteristics. This information, together with the spring-autumn Marine Resources Monitoring Assessment and Prediction (MARMAP) data, also contained in the FEIS, produces a general overview of the fish resources of the north Atlantic. More specific information can also be obtained from several sources, a partial list of which include: Bigelow and Schroeder, 1953; CNA, 1977; Colton and Temple, 1961; Grosslein and Azarovitz, 1982; Gusey, 1977; NERCOM, 1977; and TRIGOM, 1974.

Unlike the mid-Atlantic region, most finfish in the north Atlantic could be classified as residents, and not migrants. However, many of these species are extremely mobile within their general range, often covering large portions of Georges Bank in search of food and/or cover. In addition, many species, such as lobster, demonstrate an inshore-offshore movement, most often to satisfy breeding requirements. Therefore, the inshore and offshore regions of this area are strongly linked and possess important characteristics necessary for life history requirements.

Spawning on Georges Bank has been investigated by several researchers (Colton and Temple, 1961; Smith et al., 1983; Smith _et_ _al_., 1980; Smith _et_ _al_., 1979; USDOC, 1983). Data from MARMAP surveys of the northeastern United States provide one of the better seasonal representations of egg and larvae occurrence in the north and mid-Atlantic. These data showed that spawning occurs throughout the year, and in all areas of Georges Bank (Smith _et_ _al_., 1980). Concentrations of ichthyoplankton varied by season, but the within-year species composition was generally consistent from year to year.

Along the edge of Georges Bank, there exists a zone of increased topographic relief interspersed with several canyons. This area, often termed the shelf-slope zone (approximately 200 to 1,000-m water depths), contains different assemblages than shelf regions of the north Atlantic. Species known to congregate within the shelf-slope zone include tilefish, red crab, red hake, and squid. For a more complete listing of species occurence within this region, refer to Hecker _et_ _al_. (1983).

Beyond 1,000 m, fish resources can be classified as deep-sea. These species are adapted to opportunistic feeding on forage species that are distributed. Many species contain light-producing organs and demonstrate daily movements within the water column. Deep-sea demersal fish resources can be grouped into four classifications with respect to water depth: 1) middle slope (1,200 to 1,800 m) dominated by blue hake (_Antimora_ _rostrata_), _Synaphobranchus_ _kaupi_, _Coryphaenoides_ _carapinus_, _Alepocephalus_ _agassizzi_, and _Dicrolene_ _intronigra_; 2) lower slope (1,700 to 2,100 m) dominated by _A_. _rostrata_, _C_. _carapinus_, _Halosauropsis_ _macrochir_, and _S_. _kaupi_; 3) upper rise (2,100 to 2,900 m) dominated by _C_. _armatus_ and _A_. _rostrata_; and 4) lower rise ($\geq$ 2,900 m) dominated by C. armatus (Pearce et al., 1983; Musick, 1975). This same categorization and characterization generally applies to the deepwater habitats from Cape Hatteras to Nova Scotia.

Fishes of the Gulf of Maine can be generally classified as boreal in nature. They are residents of the region and demonstrate only limited movements into adjacent regions such as Georges Bank or the Scotian shelf. Data concerning specific life-history characteristics and ecological interrelationships of Gulf of Maine fish and shellfish can be found in several sources, a partial list of which include: Bigelow and Schroeder, 1953; Grosslein and Azarovitz, 1982; Hare, 1977; TRIGOM, 1976.

Spawning data for the Gulf of Maine is best represented by Smith et al, (1983). As demonstrated in other Atlantic regions, concentrations and composition of the ichthyoplankton community vary by season, but the within-year species make-up is generally consistent from year to year.

Commerical fishery landings in the Gulf of Maine give an indication of which species are economically most important. The Northwest Atlantic Fisheries Organization (NAFO) compiles catch statistics for this region on an annual basis. In 1980, 282,845 metric tons of finfish and shellfish were harvested. Finfish comprised 82 percent of the total, with the remaining 18 percent consisting of shellfish and invertebrates (NAFO, 1982). If these species are ranked in terms of metric tons landed (1980), they would appear in the following order: (1) Atlantic herring (2) Atlantic menhaden (3) Atlantic cod (4) pollock (5) American plaice (6) soft clam (7) sea scallop (8) American lobster. Many other species are harvested in the Gulf of Maine, but in 1980 the volume landed was less than 10,000 metric tons. Specific data can be obtained from the 1982 NAFO publication.

Anderson (1984) summarized commercial and sport fisheries data for the eastern United States, including the Gulf of Maine. These data indicate harvest trends, status of the stocks, long-term potential catch, and the status of exploitation. Species with concentrations in the Gulf include Atlantic cod, haddock, red fish, pollock, silver hake, yellowtail flounder, American lobster, and others. Most stocks are fully, or nearly fully exploited.

### (4) Marine Mammals

Five species of pinnipeds (seals and walruses), ranging in occurrence from common to very rare, inhabit the coastal and nearshore waters of the north Atlantic region. These species include the harbor, gray, harp, and hooded seals and the walrus. Only the harbor and gray seals occur in large numbers or with any regularity in the north Atlantic region. The distribution, habitat preference, and abundance of each species is listed in FEIS OCS Sale No. 42, Table II-49. None of these five species is on the Federal list of endangered or threatened species. There are about 26 species of cetaceans (porpoises, dolphins, and whales) that inhabit the north Atlantic region. Their distribution, habitat preference, and estimated abundance are listed in FEIS OCS Sale No. 82, Table III.B.5-1. Of these 26, approximately 16 can be found in the area on a seasonal or year-round basis. Six species are endangered: fin whale, humpback whale, right whale, sei whale, sperm whale, and blue whale.

### (5) Coastal and Marine Birds

Avian species that spend the majority of their life at sea, only coming ashore to breed or to avoid severe environmental conditions often are referred to as marine birds or seabirds. Approximately 30 species of marine birds ranging from uncommon to abundant occur in the North Atlantic Planning Area. Powers, Pittman, and Fitch (1980) studied the distribution of marine birds in the North and Mid-Atlantic Planning Areas. They examined three regions that corresponded closely to the North Atlantic Planning Area: (1) the Gulf of Maine, (2) Georges Bank, and (3) southern New England. They observed the greatest numbers of birds in the Georges Bank and Gulf of Maine regions during the summer, fall, and winter seasons. Spatial distribution of marine birds depends generally upon the distribution of prey species both natural and human-related (i.e. fishing activities). Prey species are naturally concentrated in nutrient-rich upwelling areas. In the north Atlantic these areas would include the shelf-slope area in general, the major submarine canyons, and the Nantucket Shoals area. Powers, Pittman, and Fitch (1980) have also identified the New York Bight, and the southern flank and Northeast Peak of Georges Bank as seasonally important areas for some species.

Coastal and nearshore avian species in the north Atlantic region consist of three main groups: shorebirds, wading birds, and waterfowl. Shorebirds are a closely related group of species represented in the north Atlantic by oystercatchers, plovers, sandpipers, turnstones, yellowlegs, dowitchers, godwits, and phalaropes. Shorebirds are found in most marine, estuarine, and palustrine habitats where they feed mainly on aquatic invertebrates. They utilize these coastal areas during their northerly spring migration and southerly fall migration which actually begins in mid-summer for many species. One species of shorebird, the piping plover, is one of the few shorebirds that actually nests along the north Atlantic coast. However, its numbers have declined dramatically in recent times.

### (6) Endangered and Threatened Species

The bald eagle (Haliaeetus leucocephalus) is an endangered species that is native to north Atlantic coastal areas. A small group is known to overwinter in the vicinity of the Brigantine National Wildlife Refuge in New Jersey. However, the majority of birds nest, or overwinter, along the coast of Maine. Two subspecies of the peregrine falcon (Falco peregrinus) are found in the region: American Peregrine (F. p. anatum) and Artic Peregrine (F. p. tundrius). The Arctic peregrine is listed as threatened while the American peregrine is listed as endangered. During migration periods (September-November and February-March) peregrines use remote beach areas such as Block Island, Martha's Vineyard, and Parker River National Wildlife Refuge in Massachusetts to prey on a variety of shorebirds or to rest on open beach areas.

Three endangered and two threatened species of marine sea turtles occur in the waters of the north Atlantic. The three endangered species include the hawksbill (Eretmochelys imbricata), the leatherback (Dermochelys coriacea), and the Atlantic ridley (Lepidochelys kempii). The two threatened species are the loggerhead (Caretta caretta) and the green sea turtle (Chelonia mydas).

The final results of the CETAP (1982b) study indicate that the loggerhead is the most abundant species in the region followed by the leatherback and then the Atlantic ridley. Green sea turtles prefer the warmer, more southern waters of the mid- and south Atlantic but have been recorded in small numbers in Nantucket Sound (Lazell, 1980). The hawksbill is generally considered to be only an accidental visitor to the north Atlantic. This species has not been observed by CETAP and there are no recent records of strandings in the mid- or north Atlantic regions.

The fin whale is the most abundant large endangered whale occurring in the north Atlantic region (CETAP, 1982b). This species is commonly and widely distributed over the northeastern U.S. OCS. The humpback was the second most commonly sighted large whale in the region. Sightings were concentrated in a relatively narrow band along the 100-m contour from Nantucket Shoals north to the western Gulf of Maine. Feeding activities were concentrated within this narrow band during the seasons of greatest abundance (spring, summer, and fall). The right whale is probably the most endangered marine mammal inhabiting the region based on the low number of individuals remaining in the population. This species occurs in the region in greatest numbers in the spring and early summer followed by a large decline in sightings in the late fall and winter. Calving is believed to occur during the winter. Although a definite calving ground for right whales has not been discovered, calving may be taking place in Cape Cod waters (Watkins and Schevill, pers. com., cited in Goodale, 1982). Feeding activity was noted in several areas including the interior portions of Georges Bank, the southern portion of the Great South Channel, and scattered sites in the Gulf of Maine. The sei whale is not particularly abundant in the region based on the relatively low number (CETAP, 1982b). This species has a predominately spring and summer distribution in the north Atlantic region. The sperm whale is relatively abundant in the region and generally prefers deepwater habitats (CETAP, 1982b). This species has a four-season distribution along the shelf edge centered about the 1,000-m depth contour and extending seaward of the 2,000-m contour into deeper waters over all seasons. Blue whales are extremely uncommon in the north Atlantic region. It is believed that the remaining population is confined to waters north of the region.

### (7) Estuaries and Wetlands

Narragansett Bay and many smaller estuarine systems border the north Atlantic region. There are more than 1 million acres of wetland habitat associated with these estuaries and portions of the Atlantic coast from New Jersey to Maine (Gusey, 1977). The States with the most extensive amounts of coastal wetland and estuarine zone habitat, in decreasing order, are New Jersey, New York (Long Island), Massachusetts, and Maine. However, the U.S. Department of the Interior's National Estuary Study (1970) determined that the majority of the estuarine systems and coastal wetlands bordering the north Atlantic has been moderately or severely modified, with the notable exception of the central and northern Maine coast; Cape Ann, Massachusetts; the eastern end of Long Island; and portions of Gateway National Recreation Area located at the mouth of Raritan Bay. In addition to these relatively unmodified areas, numerous State and Federal wildlife refuges and parks provide protection to valuable coastal wetlands. Estuarine sanctuaries in Narragansett Bay, and the lower Hudson estuary prohibit development of wet-lands within their sanctuary boundaries. In addition to wetlands, rocky and sandy beach-dune habitats are present along the north Atlantic coast. Rocky shorelines occur in several places along the New England coast but are most prevalent along the Maine shore. Exposed rocky shores support a dense and diverse assemblage of benthic invertebrates with the densities of some species ranging up to 160,000/m2.

### c. Socioeconomic Environment

#### (1) Employment and Demographic Conditions

Population and labor force characteristics in the north Atlantic coastal region vary widely, ranging from highly urban areas such as New York (64,922 persons per square mile and a 1981 civilian labor force of 620,232) to sparsely populated communities such as Washington County, Maine (14 persons per square mile and a 1981 civilian labor force of 15,236). This range in population density and labor-force size is indicative of the wide variation in economic structure and community organization found in this region.

#### (2) Coastal Land Uses

The north Atlantic coast extends for 700 miles from the Maine/Canadian border south through New Jersey. This coastal area combines a full spectrum of land uses from natural areas to intensively urbanized metropolitan cores.

The northern components of the region, coastal Maine and New Hampshire, are mostly composed of natural resource areas such as tidal wetlands, beaches, dunes and rocky shorelines. Shorefront areas are developed to support a seasonal tourist trade. Coastal Massachusetts supports the major metropolitan area of Boston and vicinity, smaller urban areas such as New Bedford and Fall River, and the less developed recreational attractions of Cape Cod, Martha's Vineyard, and Nantucket Island. Coastal areas of Rhode Island, Connecticut, New York (western Long Island), and northern New Jersey are largely urbanized with New York City and Boston serving as loci of a northeastern megalopolis. Eastern Long Island is less intensely developed and is an attractive second home and vacation area. Coastal land use development pressures throughout the region are substantial and are expected to continue at least for the near future.

#### (3) Commercial Fisheries

The north Atlantic region is comprised of the States of Connecticut, Rhode

Island, Massachussetts, New Hampshire, and Maine. In 1983, 711,075,000 pounds of finfish and shellfish were landed, with an ex-vessel value of $435,127,000 (USDOC, 1984). This represents 18.6 percent of the total U.S. landings, in terms of dollar value. Massachussetts is the single largest contributor (56 percent of the region), followed by New Hampshire (25 percent), Connecticut (15 percent), Maine (3 percent), and Rhode Island (1 percent). North Atlantic shellfish landings comprised just over half (57 percent) of the regional landings, in terms of value.

The top ten commercial fisheries, in order of decreasing dollar value are: American lobster, sea scallop, cod, yellowtail flounder, flounder (unclassified), haddock, hard clam, winter flounder, soft clam, and shellfish (other). When compared to the total U.S. species-specific landings data (ex-vessel value), this region accounts for 100 percent of the haddock, 94 percent of the American lobster, 68 percent of the sea scallops, and 67 percent of the cod landed in the Nation. These four species are very important throughout the New England region, and even nationally. The north Atlantic region is the sole source of domestic haddock, and the principal source of lobster, scallops, and cod.

Major fishing ports in the north Atlantic, listed in order of decreasing dockside value are: New Bedford (MA; #1 in the U.S.), Gloucester (MA; #8 in the U.S.), Point Judith (RI), Portland (ME), Rockland (ME), and Boston (MA). Unlike other Atlantic regions, the offshore portions of the North Atlantic Planning Area are comparatively more important than nearshore waters. In 1983, only 39 percent of the finfish and shellfish landed in the New England region came from waters within the Fishery Conservation Zone (FCZ), which consists of waters within 3 miles of shore. The importance of offshore waters is directly attributable to the presence of Georges Bank. Georges Bank represents a unique area within the northwest Atlantic. The complex interaction of oceanographic, topographic, and meteorologic parameters result in environmental conditions which sustain a high biomass of commercially important finfish and shellfish. All sections of Georges Bank are fished by the commercial fishermen of New England. For example, sea scallops are harvested from the Great South Channel; American lobster from the shelf-slope region; cod, haddock, and flounders from the remaining areas of the Bank and southern New England.

### (4) Recreation and Tourism

Coastal recreational activities popular in the north Atlantic include swimming, windsurfing, sunbathing, beach hiking, boating, fishing, hunting of waterfowl, bird watching, and whale watching. Participation in all of these activities is high, but the peak season for each activity is relatively short because of the climate. July and August comprise the peak season for swimming and beach use, whereas the spring and the fall migration periods are peak times for bird and whale watching. Much of the Atlantic coast from Maine through New Jersey is heavily used for recreation and open space. Major Federal and State parks and recreation areas cover large expanses of the coastline.

The southeastern portion Massachusetts includes the major tourist magnets of Cape Cod, Martha's Vineyard, and Nantucket Island with annual visitation in excess of 5 million per year for coastal parks alone. Overall, these areas accommodate more than nine million recreational visitors per year with direct spending of $287.8 million (Cournoyer and Kindahl, 1980). The coast of Rhode Island and Narragansett Bay has a long history of recreational use. Boating is an extremely popular form of recreation in the State, and Rhode Island's shoreline possesses a considerable stock of seasonal housing which results in peak season annual visitor expenditures estimated at $223 million (Rhode Island Department of Economic Development, 1980). Connecticut's shoreline with numerous saltwater beaches is also heavily used for water oriented recreation, often in excess of capacity.

In general, figures on demand for coastal recreation show that there is even greater demand than actual use. Supply is often limited by access problems, such as the availability of parking or public transportation, or lack of rights-of-way to reach coastal areas. States are addressing the problems of increasing access where feasible. Information on demand and supply is covered in each State's Statewide Comprehensive Outdoor Recreation Plan (SCORP).

### (5) Archaeological Resources

For the north Atlantic region, there exists the possibility that prehistoric archaeological resources may be present on portions of the shelf surface which were exposed as early as 18,000 YBP (Years Before Present). This zone most likely occurs in areas where the present water depth is 30 to 40 m or less. Even then, localized oceanographic conditions may have resulted in destruction of archaeological resources which may have been present, such as on Georges Bank proper where severe wave and erosional conditions exist. In general, areas of medium to high archaeological probability occur in the shallow areas adjacent to the coastline. The area south and southeast of Nantucket also is considered an area having medium to high probability of containing prehistoric archaeological resources. Numerous shipwrecks are also scattered throughout the North Atlantic Planning Area.

### (6) Marine Vessel Traffic

There are four major ports in the New England region. Following is a listing of these ports: Boston, Massachusetts; Portland, Maine; New Haven, Connecticut; and Providence, Rhode Island. Other important New England ports, although of considerable less importance are as follows: Fall River, Massachusetts; Bridgeport, Connecticut; Portsmouth, New Hampshire; New London, Connecticut, and Searsport, Maine. With the exception of Portland, which has a depth of 45 feet in the main ship channel, the depths of the major ship channels at all of the above ports range between 30 and 40 feet (U.S. Army Corps of Engineers, 1981).

Petroleum products account for over 70 percent of the tonnage handled at all the major New England ports with the exception of Portland. Approximately 54 percent of the tonnage handled at Portland consists of imported crude petroleum. From Portland the oil is transported via pipeline to refineries in the Montreal, Canada area.

The Davisville/Quonset, Rhode Island port complex is located along the west passage of Narragansett Bay approximately 20 miles south of Providence. This complex has been serving as the supply base for OCS exploration activities in the north and mid-Atlantic.

Traffic Separation Schemes (TSS's) and Precautionary Areas (PA's) have been established by the Coast Guard and adopted by the International Maritime Organization (IMO, a branch of the United Nations), in an effort to reduce the possibility of collisions between vessels entering and exiting major port areas. TSS's and precautionary areas have been established in the north Atlantic at the approaches to Portland and Boston harbors, Narragansett and Buzzards Bays and to New York and Delaware Bays in the mid-Atlantic.

### (7) Military Uses

Portions of the water and air space of the North Atlantic Outer Continental Shelf and adjacent shoreline are used for various military operations essential to training, readiness, and support of national defense and security interests. These operations include training and testing activities such as submarine operations, gunnery practice, sea trials, radar tracking, warship maneuvers, and general operations. These activities normally take place in areas specifically designated for such purposes that are under the control of the Department of Defense. (Figure III.A.1.a.6-1).

## 2. Mid-Atlantic

### a. Physical Environment

#### (1) Geology

The mid-Atlantic region structurally is dominated by the Baltimore Canyon Trough, an elongated depression in the crystalline basement rock. The trough extends from the vicinity of Cape Hatteras northeastward approximately 500 km (300 mi) to terminate against the Long Island Platform. Geologists believe the trough formed in the late Triassic when an ancient supercontinent separated along a rift zone to create the early Atlantic Ocean. The edge of the rift zone subsided along faults, and sediments eroded from the continent to the west were deposited in the area that has become the continental margin. Deposition and subsidence continued, resulting in an accumulation of sediments greater than 15 km thick in places, which were deposited under marine and non-marine conditions.

The most prospective part of the Mid-Atlantic Planning Area is the zone of thick sediments in the Baltimore Canyon Trough. The "Reef Trend" and its associated fore and back reef structures are considered part of this zone. Several wells drilled in 1984 on and near the reef were dry.

#### (2) Geologic Hazards

Sediment mass movement is the major geologic process which could be hazardous to oil and gas drilling in the Mid-Atlantic Planning Area. Restricted in occurrence to the continental slope and rise, mass movement is considered the dominant process shaping the submarine canyons. The canyons serve to focus tidal currents and possibly Gulf Stream eddy currents which, in conjunction with bioerosion, undercuts the canyon walls, weakening the sediment layers to the point that they slump, slide, or collapse into debris flows. There is evidence that this is a present-day process in many of the canyons; however, for unknown reasons, some of the canyons appear to be quiescent. The intercanyon ridges show evidence of sparsely scattered mass movement. The area between Mey and Hudson Canyons seems to be an exception. The majority of the slope in this area has undergone some kind of mass movement, most of which consists of differential compaction. Most authors indicate that intercanyon mass movement features are probably Pleistocene in age and not a contemporary process. Additional hazards which have been noted in the mid-Atlantic are very sparsely scattered. Shallow faulting of apparently recent occurrence has been observed on the shelf and slope and shallow gas has been noted on the shelf, slope, and rise. The most widespread potential for shallow gas may be in the zone of clathrates (frozen gas hydrates) which occurs along the continental rise from 2,500 m to 3,800 m deep. Clathrates can cap gas deposits that are over-pressured.

Other geologic features found in the mid-Atlantic area, which can have adverse effects on drilling are: seafloor scour, filled channels, shallow faults (with no recent movement), and gassy sediments. These features are considered constraints as current drilling technology can reduce the adverse effects to an acceptable level.

### (3) Non-Petroleum Mineral Resources

The major non-energy minerals in the mid-Atlantic are sand, gravel, and placer deposits of heavy minerals (e.g. gold, platinum, ilmenite, staurolite, rutile, etc.). Sand can be found in many areas where waves or paleo-rivers winnowed the fine materials out, leaving behind the sands. These winnowed deposits are also prime sites to find heavy minerals. The same forces which concentrate the sands also tend to concentrate the heavy minerals.

Presently there is no offshore mining in the mid-Atlantic, however, as the populated areas deplete their onshore sources of building aggregate, the continental shelf will become a major supplier. The association of heavy minerals with sand and gravel deposits enhances the value as two resources can be exploited essentially for the price of one. Tight supplies of titanium and platinum in addition to the increasing need for sand and gravel could mean offshore mining not too many years in the future.

### (4) Oceanography

#### (a) Chemical

The mid-Atlantic surface water is characterized by three general water masses (shelf, slope, and Gulf Stream water), each having distinct physical, chemical, and biological characteristics. The shelf water has relatively low salinity and shows seasonal temperature variability, whereas the Gulf Stream water is less variable and has characteristically higher temperature and salinity. The slope water (including rise water) represents a mixing or transition area between the adjoining shelf and Gulf Stream waters.

Sampling of the middle and outer continental shelf waters from Cape Hatteras to Nova Scotia (Matte et al., 1983) has demonstrated considerable variation in nutrient concentrations and a general increase in concentration with depth; only nitrate showed a consistent concentration increase seaward. Dissolved oxygen levels in waters of the shelf and upper slope reflect seasonal mixing and stratification patterns. Whereas, in 1975-76, oxygen levels were noted at 5 to 10 mg/l throughout the water column during the fall, anoxic (oxygen-depleted) water was found along the bottom of the inner shelf during the strong vertical stratification period in summer (Ruzecki et al., 1977).

#### (b) Physical

Water characteristics within the Mid-Atlantic Planning Area correspond to those of shelf, slope, and Gulf Stream waters. Shelf waters are relatively low in salinity and subject to relatively strong seasonal cooling and warming as well as tidal effects. Slope waters are transitional between the shelf and the Gulf Stream waters. The circulation of the slope waters consists of an elongated gyre, according to Williams and

Godshall (1977). The Gulf Stream flows to the northeast. Events of the Stream (meanders and eddies), as in the north Atlantic, strongly influence the physics of the planning area.

The highest waves in the area are observed during the winter months (December, January, and February). Canyon circulation is similar to that of North Atlantic canyons.

This area is also subject to nor'easters and hurricanes. Hurricanes are of greater concern here than in the north Atlantic, but less so than in the South Atlantic Planning Area.

### (5) Water Quality

Water quality in the mid-Atlantic outer continental shelf, slope, and rise area appears generally good in that the ambient water is affected (degraded) only to a small degree from man-made inputs. Some limited water quality degradation results from ocean dumping (at the former 106-Mile Ocean Waste Dump Site) and along the shelf as the heavily contaminated inner New York Bight area is approached. Studies conducted of shelf and upper slope waters along the Middle Atlantic Bight generally indicate low or non-detectable levels of petroleum hydrocarbon, no unusually high trace metal concentrations, and generally low levels of suspended particulates.

Some nearshore (coastal) areas of the Middle Atlantic Bight have degraded water quality from pollution inputs associated with estuarine and/or river outflows and ocean dumping operations. Water quality problems reported in the inner New York Bight include sewage-related high BODs, excessive bacterial densities, oil and grease, and high concentrations of heavy metals, poly-chlorinated biphenyls (PCBs), and other potentially toxic concentrations of suspended matter, resulting from the dumping of dredged material and sewage sludge as well as from estuarine runoff (US EPA, 1978).

### (6) Ocean Dumping

There are 10 active, dredged materials dumpsites located near-shore (usually less than 3 nautical miles from shore) in the mid-Atlantic (40 CFR 228.12, July 1, 1983). (Figure III.A.2.a.6-1). Except for the Mud Dump Site (immediately east of Sandy Hook, New Jersey) which was designated "final" (Federal Register, May 14, 1984), the other dredged materials sites have "approved interim" status, meaning that environmental studies for determining impact and continued use have not been completed by the U.S. Environmental Protection Agency.

Within or close to the New York Bight Apex area, the active dumpsites include those desig-nated for acid waste, cellar dirt, and wood incineration (periodic use). U.S. EPA has indicated that use of the 12-mile Sewage Sludge Dumpsite will be discontinued (Federal Register, May 4, 1984), however, this use termination is presently proceeding in a phased manner. The dumpsite for wrecks is presently inoperative. Further offshore in the

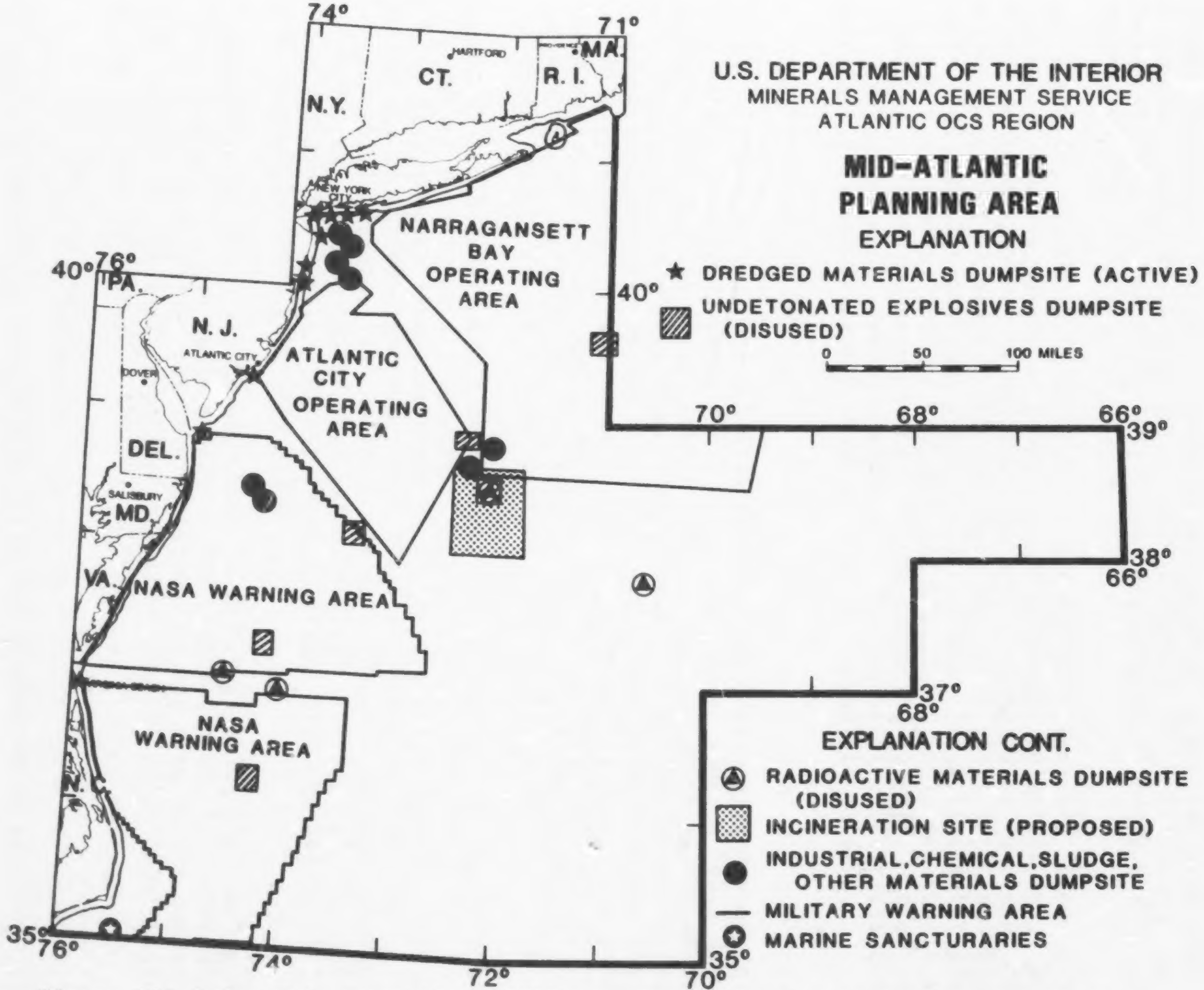


Figure III.A.2.a.6-1. Dumpsites, Military Areas, and Marine Sanctuaries in the Mid-Atlantic Planning Area.

Middle Atlantic Bight, industrial wastes and a small amount of municipal sludge have been dumped since 1961 at a large site (106-Mile Ocean Waste Dump Site). On May 4, 1984, U.S. EPA designated two new, much smaller disposal sites within and as a replacement for the previously interim-designated 106-Mile Site (Federal Register, Vol. 49, No. 88). The new eastern site is for disposal of municipal sludge (Deepwater Municipal Sludge Site) and the western site is for disposal of aqueous industrial wastes (Deepwater Industrial Waste Site). Adjoining the 106-Mile Site is an extensive area designated by U.S. EPA (proposed North Atlantic Incineration Site) for potential at-sea incineration of toxic organic wastes (US EPA, 1981).

Additionally, scattered throughout the mid-Atlantic area are former sites, presently inactive, used for dumping of undetonated explosives (e.g. bombs, mines, munitions, etc.)--6 major sites, and for dumping of low-level radioactive materials--4 major sites (US EPA, 1980; NRC, 1981; Smith and Brown, 1971; 1982 NOAA Navigational Chart 13003). These radioactive materials include by-products, such as contaminated gloves and tools encased in steel drums, as well as the reactor shell of the submarine Seawolf. Locations of the undetonated explosives and especially the radioactive materials dumpsites are only approximately known because of incomplete records.

### (7) Climate

In the western part of the Mid-Atlantic Planning Area the mean wind velocity ranges from approximately 8 knots in the winter (Dec. - Feb.) down to approximately 4 knots in the summer (June - Aug.). Typically the predominant wind direction shifts from west-northwesterly during the winter months to south-southwesterly during the summer. The wind velocities are usually appreciably greater in the eastern part of the planning area. The wind speed during the winter months averages greater than 20 knots out of the northwest, but decreases to less than 15 knots out of the southwest during the summer months in the eastern part of the planning area.

Storms in the Mid-Atlantic Planning Area are typically from two origins; tropical or extratropical regions. Tropical storms (between 34 and 63 knots) may generate into hurricanes ($> 64$ knots), which are most common during August through September, with their accompanying high waves. Extratropical cyclones (nor'easters) are more frequent between October and April and may produce higher waves than hurricanes because of the longer fetch (distance a constant direction wind travels over the sea surface) that is usually found with such storms.

Temperatures in the planning area usually do not go below 0° C during the winter months. In the eastern part of the planning area, the temperature may fall below freezing less than 20 percent of the time during January. Temperatures in the western part of the area are typically higher because of the warming influence of the Gulf Stream.

### (8) Air Quality

Air quality conditions within each State are determined by existing levels of specified pollutants. These pollutants, for which the U.S. Environmental Protection Agency (EPA) has established primary and secondary National Ambient Air Quality Standards are ozone (O3), carbon monoxide (CO), nitrogen dioxide (NO2), sulfur dioxide (SO2), total suspended particulates (TSP), and lead (Pb). Primary standards are designed to protect public health; secondary standards are intended to protect public welfare, including esthetic values. The 1977 Clean Air Act Amendments require all areas of the country to be categorized according to their NAAQS attainment/non-attainment status for the specific pollutants. Also, States have been required to sumit to the EPA for approval State Implemental Plans (SIPs) for attaining compliance with the NAAQS.

The States of Massachusetts, Rhode Island, New York, New Jersey, Pennsylvania and Delaware all have at least one area which is currently non-attainment for one or more of the criteria pollutants listed above. No coastal areas of Maryland, Virginia or North Carolina have been designated "non-attainment" for the criteria pollutants.

## b. Biological Environment

### (1) Plankton

Planktonic organisms are defined as floating or weakly swimming organisms that cannot maintain their distribution against movement of the water masses in which they live. The planktonic community basically is divided into two major trophic categories: phytoplankton--the autotrophic organisms which photosynthesize; and zooplankton--the heterotrophic organisms which feed on other plankton.

Phytoplankton on the Middle Atlantic Bight shelf demonstrate seasonal fluctuations with highest concentrations present between December and March, and a secondary peak between May and August (NEMP, 1981). Marshall (1976; 1982a) reported that the Middle Atlantic Bight coastal waters had a lower number of dominants and a lower species diversity than the south Atlantic area. However, like the south Atlantic, the areas of increased abundance corresponded with nutrient enrichment from rivers or upwelling. Small (<20 um) chain-forming diatoms are dominant inshore and during the spring and fall blooms, while the larger (>100 um) diatom species can be found year-round but are relatively more important over the mid-shelf and during summer and winter (Marshall, 1982b). The author further noted that dinoflagellates decreased in number in the seaward direction, but not as quickly as the diatoms, and therefore became relatively more important in the phytoplankton community over the mid-shelf, beyond the shelf break, and over the outer shelf when not in areas of increased diatom abundance resulting from upwelling of nutrients. Coccolithophores, cyanophyceans, and ultra-plankton (or nannoplankton) are important components of the phytoplankton, with the cyanophyceans found predominantly in near coastal water and coc-colithophores and ultraplankton found over the entire shelf. O'Reilly and Busch (1984) have indicated that primary production in the mid-Atlantic shelf euphotic zone remained at about 1 g carbon/m2/day throughout the summer, and that the nannoplankton component was responsible for incorporating the majority of organic carbon over the year. The highest values of primary production were recorded in the apex of New York Bight and were approximately 2.5 g carbon/m2/day in spring, summer, and fall.

In the Middle Atlantic Bight there are three basic sources of zooplankters: offshore Gulf Stream and slope waters; shelf waters of southern New England and Georges Bank; and *in situ* recruitment to the meroplanktonic community from spawning adults. Tropical and subtropical species are introduced into the Middle Atlantic Bight by means of the advective movements of anticyclonic Gulf Stream eddies which generally progress in a southwesterly direction in the mid-Atlantic (Grant, 1979). Grant (1979) also reports that boreal species of zooplankton are transported to the area in the general south-southwestern movement of mid-Atlantic shelf waters. In both cases, the survivorship of the various species depends on temperature, and therefore season, of the receiving waters--the boreal species normally evident in winter and spring and the tropical-subtropical species found in summer and fall. Grant (1979) also states that the presence of a Coastal Boundary Layer of water is evident throughout the mid-Atlantic and is a means of southward transport of coastal species. The author reported that zooplankton volumes (biomass) varied seasonally--the maximum in spring and the minimum in fall. He also indicated that inshore and offshore volumes varied with the inshore highest in the summer, the mid-shelf highest in winter and spring, and the shelf edge highest in the fall. The author also noted that a north-south difference in volumes was apparent, with the southerly transect having higher values in fall and winter and lower values in spring and summer. Grant (1979) also noted that, irrespective of the season, the Middle Atlantic Bight zooplankton tended to occur in three distinct communities: 1) a coastal community delineated by the Coastal Boundary Layer; 2) a mid-shelf community; and 3) an offshore community comprised of slope and occasional Gulf Stream species. During the same study the neuston (those organisms living at or near the water's surface) was sampled to a depth of 10 to 12 cm. Diel migration patterns of neustonic species fell into three general categories: 1) no change over 24 hours (no diel migration); 2) increased abundance at night; and 3) crepuscular (dawn and dusk) peaks of abundance. The neuston species were reported to be reasonably predictable in the coastal waters, but unpredictable in mid-shelf and shelf-edge waters. This was attributed to dependence of the faunal community structure upon the incursion of southern New England waters or Gulf Stream warm-core eddies into the area and how recently it occurred (Grant, 1979; Cox and Wiebe, 1979). Grant (1979) attributes the neustonic layer with being a valuable nursery habitat for numerous trophically and commercially important species which have meroplanktonic larvae. The larvae of mid-Atlantic decapods and fish often were dominant numerically in the neuston community.

### (2) Benthos

#### (a) Intertidal

Intertidal fauna in the area show the same marked vertical zonation found worldwide. Gastropods of the genus *Littorina* occur in the splash zone above the highest tides. *L. saxatilis* is restricted to northern areas. *L.*

*littorea*, the edible periwinkle introduced from Europe, is very abundant north of New Jersey. Other littorinoids are found at a lower level among algae (*L. obtusata*) and in salt marshes in southern areas (*L. irrorata*).

Barnacles occupy a zone approximately 4 feet high on the open coast, reaching to the level of highest high tides. In southern New England *Balanus balanoides* dominates this zone. The smaller *Chthamalus fragilis* is much less abundant. In New England *B. eburneus* and *B. improvisus* are restricted to brackish water, but they extend into fully marine habitats in the southern area.

The edible mussel, *Mytilus edulis*, lives subtidally and occurs in large numbers up to the mid-tide level. The gastropods *Thais lapillus* (northern region) and *Urosalpinx cinerea* are predators of both mussels and barnacles. They retreat to the mussel zone and to crevices during low tide.

Animals that are more abundant at continuously moist levels include the starfish, *Asterias forbesii*, anemones, hydroides, bryozoans, tunicates, amphipods, and sea urchins.

It appears that the total number of intertidal species in the Mid-Atlantic Bight is lower than in areas farther north and much lower than in northern Pacific areas. Newell (1970) and Lewis (1964) show the extent to which wave exposure, topography, and substratum modify a primary zonation pattern established by feeding type, and resistance to heat, dessication, and fresh water. In southern New England wave exposure extends intertidal faunal zones 1-2 feet above those levels predicted from considerations of the species' resistance to drying and fresh water inundation.

The eastern oyster, *Crassostrea virginica*, is a dominant species on hard substrates in estuaries throughout the study area. In the southern part of the Mid-Atlantic Bight reefs of oyster shells become significant topographic features. These reefs occur only intertidally in salinities over about 18%. At higher salinities predation by *Urosalpinx cinerea* reduces abundance and boring by the sponge, *Cliona celata*, prevents accumulation of shell (Wells and Gray, 1960b). In areas with lower and variable salinities reefs develop subtidally.

Members of the oyster reef community included sessile polychaetes and mollusks (*Anomia*, *Crepidula*, *M. edulis*, *Brachidontes*); species burrowing into shells (*Cliona*, the polychaete *Polydora websteri*); predators (the drills *Euplieura caudata* and *U. cinerea*, the flatworm *Stylochus ellipticus*); species associated with oysters (the crab *Pinnotheres ostreum*, and the ectoparasitic snail *Odostomia*); and deposit feeders occupying organic rich sediments trapped among the shells (the polychaetes *Amphitrite ornata*, *Neanthes succinea*).

### (b) Subtidal

The benthic habitat of the mid-Atlantic region is characterized by a medium-grained sand inshore grading to finer sediments at the shelf break. The shelf demonstrates a ridge-and-swale (hill-and-valley) topography on the inner shelf and part of the outer shelf with the ridges having coarser surficial sediments than the swales. At the shelf break, the topography is modified by the major submarine canyons which incise the shelf to varying distances shoreward and form complex benthic habits. The continental slope sediments are made up of clays on the upper slope and change to fine silts on the continental rise. The slope area between the major canyons can show diversified types of topography from smooth slope to rugged configuration in areas of minor canyons caused by mass wasting.

The fauna in the Middle Atlantic Bight region is dominated by four groups: Arthropoda; Annelida; Mollusca; and Echinodermata. These four groups are dominant in terms of numerical abundance as well as biomass, however the relative ranking changes depending on which measure is used (Wigley and Theroux, 1981).

Boesch (1979) reported on macroscale and mesoscale patterns of benthos distribution in the mid-Atlantic region. The author concluded that no latitudinal (north-south) variation of across-shelf macrobenthos distribution was evident within the sampled area. Boesch (1979) reported that annelids (primarily polychaetes) were the numeric dominants over the shelf whereas Wigley and Theroux (1981) rank annelids third, behind arthropods and behind mollusks also reported in the Middle Atlantic Bight. Boesch's (1979) density values generally range from 2,000 to 10,000 individuals per m2 and are typically greater than 2 times higher than Wigley and Theroux's (1981) values which had a mean of 1,400 individuals per m2. This is predominantly because of the finer sieve mesh size used by Boesch. Biomass estimates were equivalent between the two studies-another indication that Boesch's (1979) numerical data were composed of smaller individuals. Boesch (1979) also proposed a five-zone faunal pattern: inner shelf, 0-30 m; middle-shelf, 30-50 m; outer shelf, 50-100 m; shelf break, 100-200 m; and slope >200 m--with mesoscale density trends correlating with shelf topography--ridges and swales. The author reported that the inner and mid-shelf zones supported lower densities of organisms than did the outer shelf and shelf break. The swale habitats also tended to have greater densities than the ridges; swale habitats had densities about 2 to 3 times higher than adjacent habitats. Densities on the slope quickly decreased with depth. The upper slope had a median density of 2,000 individuals per m2 and the middle slope decreased to a median density of 390 individuals per m2.

Although, in general, the biomass and numbers of organisms decrease in a seaward direction from the outer shelf to the slope and beyond, submarine canyons have been shown to have increased biomass and numbers of organisms. The submarine canyons offer a unique environment for the concentration of fauna. The primary reason for increased density is the complex topography located at the canyon heads and along the shear walls. In conjunction with increased niche space because of topographic complexity, increased attachment substrate in the form of consolidated sediment or rock scarps allows sessile invertebrates to colonize these areas, thereby increasing the available niches for other fauna which may associate with these colonies. It also has been postulated that submarine canyons may act like terrestrial watersheds, which concentrate water and waterborne materials to a main river channel. The canyons would concentrate the fine sediments and dissolved and particulate nutrients--such as particulate organic carbon (POC)--which flow off the shelf in the main axes of the canyons. The increased nutrient input would allow higher densities of organisms (primarily filter and deposit feeders, but also any associated organisms such as their predators).

Hecker *et al*. (1980) conducted photographic surveys of two north Atlantic and one middle Atlantic (Baltimore) canyons. They noted that the faunal density in Baltimore Canyon was highest in the 300-to-399-m depth interval primarily because of high concentrations of the polychaete *Hyalinoecia artifex*. The authors stated that the middle Atlantic canyon most closely resembled a slope habitat of the three canyons studied and exhibited the least substrate variability.

An early study of the Hatteras Canyon system used bottom photography to study faunal zones (Rowe, 1971). The author proposed that submarine canyons have unique assemblages which disrupt the horizontal bands of faunal zonation along the continental shelf. Rowe (1971) further suggested that the presence of, or decreased abundance of, certain species could be designated as canyon indicators. He also stated that the presence of the suspension feeders *Ceriantheomorphe braziliensis* and *Kophobelemnon stelliferum* at the head of Hatteras Canyon indicated elevated levels of suspended particulates flowing down-canyon.

Haedrich *et al*. (1975) used a trawl survey to delineate faunal zonation on the Middle Atlantic Slope south of New England. They concluded that the small Alvin Canyon did not contain a unique fauna. However, the presence of certain species such as the echinoderm *Amphilimna olivacea*, or the absence of other species such as the polychaete *Hyalinoecia artifex*, could be considered as "canyon indicators." It should be noted that only seven samples were obtained in the canyon complex and, because of the limitations of using a trawl as the sampling gear, the more rugged head of the canyon was not sampled.

Hecker and Blechschmidt (1980) reported that coral populations tended to be more diverse in middle and north Atlantic canyon habitats than the slope areas. The primary reason for increased diversity in the canyons was those species restricted to hard substrates were found only in canyons but soft substrate types were found both in the canyons and on the slope. Hecker *et al*. (1983) studied faunal differences between canyons and slopes in the middle and north Atlantic areas. The authors reported that no consistent differences between canyon and slope faunal densities were found in the middle Atlantic area. However, their slope II area contained a small canyon (Hendrickson) which could have complicated the analysis.

Generally, the available studies on middle (and north) Atlantic canyons indicate that canyons make the slope into a complex habitat by incising into the slope and shelf. Faunal densities are usually higher in canyon areas because of increased attachment substrate which is generally not available on the smoother slope. Additionally, the increased colonization by epifauna on the hard substrate allows increased population levels of associated fauna. Several studies, primarily from inference, suggest that the faunal densities of filter and deposit feeders may increase inside canyons. This could result from an increased nutrient input which may be channeled and concentrated by the dendritic canyon system.

### (3) Fish Resources

The fish resources of the middle Atlantic contain species of boreal (arctic) and subtropical affiliation. This diversity is the result of the extremely wide variances in environmental conditions that occur in the mid-Atlantic. Inshore estuarine habitats are often frozen in the winter, but reach near tropical temperatures during the summer. These fluctuations produce distinctly different winter and summer finfish populations, with rather extensive migrations demonstrated by many species. Movements, may be either north-south, inshore-offshore, or both. Selected mid-Atlantic finfish and shellfish are described with respect to distribution and feeding preference in the DEIS for Sale No. 111.

The bays and coastal areas of the middle Atlantic region are valuable areas, both as productive inshore habitats and as nursery grounds for many species distributed over the continental shelf. These habitats support such species as blue crab, weakfish, scup, bluefish, spot, red drum, croaker, menhaden, flounder (fluke), striped bass, hard clam, soft clam, bay scallop, and oyster. Inshore habitats that support the above mentioned adult fish resources also contain large numbers of juvenile fish. It would appear that juvenile abundance of all species seems to be greatest in regions close to shore.

Shellfish abundance and biomass have been known and documented in the middle Atlantic (Azarovitz *et al*., 1981; New Jersey Department of Environmental Protection, 1981; Grosslein and Azarovitz, 1982; McHugh and Ginter, 1976). Nearshore and coastal habitats contain locally concentrated populations of such species as bay scallop, oyster, hard and soft clam. Farther offshore, broad distributions of surf clam, ocean quahog, and sea scallop are found. Within these general ranges, aggregations occur, such as the known sea scallop beds near Hudson, Baltimore, and Norfolk Canyons (Posgay, 1982).

Distribution of mid-Atlantic ichthyoplankton (fish eggs and larvae) has been studied by Smith *et al*. (1980). Figures depicting sampled concentrations of mid-Atlantic eggs and larvae, as reported by year and season, are contained in Appendix G of the DEIS for Sale No. 111. In general, eggs and larvae are found over nearly all the continental shelf, with a peak in abundance demonstrated in late spring and summer, if sand lance data are not included. Sand lance (*Ammodytes* spp.) is an important forage species in the mid-Atlantic and contributed almost exclusively to the winter peak observed by Smith *et al*. (1980). The majority of the eggs and larvae are planktonic, and, therefore, subject to prevailing current dispersal in upper water layers.

Along the edge of the middle Atlantic continental shelf (approximately 150-to-400-m water depths) is a region of increased topographic relief.

Canyons such as Norfolk, Washington, Accomac, Baltimore, Wilmington, Hudson, Block, and others occur within this region. Such demersal species as tilefish, red crab, and lobster congregate in and about these areas of increased relief. Pelagic species such as mackerel, tuna, squid, billfish, swordfish, and butterfish also occur in waters over canyon and intercanyon areas throughout the mid-Atlantic shelf and slope.

The deep-water fauna (>1,000 m of water) in the mid-Atlantic are very similar to those described in the north Atlantic.

### (4) Marine Mammals

There are two species of seals which can be found in the mid-Atlantic region: the harbor and the gray seals. Neither is listed as endangered or threathened. The harbor seal is an occasional visitor to coastal areas south of Cape Cod during winter months only preferring more northern waters during the rest of the year. A small group (10 to 15) of gray seals inhabits Muskeget Island off the southern coast of Massachusetts.

There are about 30 species of cetaceans which can occur in the mid-Atlantic region (their distribution and habitat are summarized in Table III.B.5-1, FEIS Sale No. 82). Of the 30, approximately 12 can be seen in the area on a seasonal or year-round basis. Six species are endangered. They are the blue whale (Balaenoptera musculus), fin whale (B. physalus), sei whale (B. borealis), humpback whale (Megaptera novaengliae), right whale (Eubalaena glacialis), and the sperm whale (Physeter catodon). The remaining, non-endangered cetaceans inhabiting the mid-Atlantic region share several traits in common. They are generally smaller in size but greater in number than the larger endangered whales. The most abundant species include the bottlenosed dolphin, harbor porpoise, whitesided dolphin, pilot whale, grampus, and the common dolphin (CETAP, 1982b). The majority are odontocete (toothed) whales that feed primarily on small fish or squid. Feeding activity by these whales is centered around the continental shelf edge (>200 m); however, a few species (e.g. minke whale, harbor porpoise) prefer the shelf proper (<200 m). The majority of odontocete feeding observations occurred during the spring and summer seasons (CETAP, 1982b). It is widely believed that the non-endangered cetaceans are migratory in nature, as are the larger endangered whales.

### (5) Coastal and Marine Birds

There are approximately 60 species of marine birds ranging from rare to abundant that transit the mid-Atlantic region. Ten of these species are considered common or abundant in the region (between 35° N latitude and 44° N latitude) during certain seasons of the year. Recent studies (Erwin, 1979; Powers et al., 1980) have found that the mid-Atlantic region is important to seabirds during their breeding and migration periods. However, the greatest numbers of marine birds concentrate in more northern waters beyond the planning area. A notable exception is the red phalarope which migrates along a relatively narrow corridor over the slope during April and May in densities of 100 to 1,000 birds/km2 (Powers et al., 1980). In the mid-Atlantic, important feeding areas include the shelf-slope area in general, the major submarine canyons, and the Nantucket Shoals area. The New York Bight and the northern Chesapeake Bight also have been identified as seasonally important areas for some species (Powers *et al*., 1980; Rowlett, 1980). Commercial fishing grounds are also important feeding areas for many species, particularly gulls. Several species of seabirds breed in the coastal zones of each of the mid-Atlantic States, with Virginia, New Jersey, and Long Island, New York harboring the largest nesting populations. Shorebirds, wading birds, and waterfowl are found in most marine, estuarine, and palustrine habitats where they feed mainly on aquatic invertebrates. They frequent these coastal areas during their northerly spring migration and southerly fall migration which actually begins in mid-summer. Cape May County, New Jersey, is one of the most important zones in the western hemisphere for migratory shorebirds with peak spring numbers occurring from April 10 to May 30 (Harrington and Leddy, 1980). The reciprocal fall migration also uses the county to a great extent.

### (6) Endangered and Threatened Species

The bald eagle (*Haliaeetus leucocephalus*) is an endangered species that is native to the Atlantic coastal zone. In the mid-Atlantic coastal zone, the Delaware Bay is the northernmost eagle nesting area; however, the highest concentration of nests occurs in the tidal areas surrounding the Chesapeake Bay and along the Delmarva Peninsula. There are two subspecies of the peregrine falcon found in the region: American peregrine (*Falco peregrinus anatum*) and Arctic peregrine (*F. p. tundrius*). The Arctic peregrine (threatened) breeds in the North American tundra, and migrates along the entire U.S. east coast where it is the most common of the two subspecies. The native breeding population of American peregrines (endangered) is considered to have been extirpated in the eastern United States. However, peregrine falcons have been reintrocuced in the Atlantic coastal zone.

Three endangered and two threatened species of sea turtles occur in the waters of the mid-Atlantic. The three endangered species include the hawksbill (*Eretmochelys imbricata*), the leatherback (*Dermochelys coriacea*), and the Atlantic ridley (*Lepidochelys kempii*). The two threatened species are the loggerhead (*Caretta caretta*) and the green sea turtle (*Chelonia mydas*). The final results of the CETAP (1982b) study indicate that the loggerhead is the most abundant species in the region followed by the leatherback and then the Atlantic ridley. Green sea turtles prefer the warmer and more southern waters of the south Atlantic, but have been recorded in small numbers in Nantucket Sound (Lazell, 1980). The hawksbill is generally considered to be only an accidental visitor to the mid-Atlantic region. This species has not been observed by CETAP and there are no recent records of strandings in the region. Migration routes for sea turtles are not well-defined. It was speculated that leatherbacks use the Gulf Stream as a migratory pathway to the Gulf of Maine (CETAP, 1981). However, there is no information available to support this hypothesis. In general, it appears that these turtles migrate north in the spring and summer to rich feeding grounds and return south in the fall and winter to breed in warm tropical waters.

There are six species of endangered marine mammals found in the mid-Atlantic region. They are the fin, humpback, right, sei, sperm, and blue whales. The fin whale is the most abundant large whale occurring in the mid-Atlantic region (CETAP, 1982). This species is commonly and widely distributed over the northeastern U.S. OCS. Spatially, the species occurs in nearly all areas of the OCS but tends to occupy the shelf proper rather than the shelf edge, a characteristic it shares with the other baleen whales. The species is present in most areas on a year-round basis with greatest numbers occurring in the spring and summer. The waters off the eastern tip of Long Island are areas of concentrated feeding activity. The humpback whale is considered to prefer shallow (less than 200 m) coastal waters; however, very few recent sightings have been made of this species in shallow coastal waters in the mid-Atlantic region. The right whale is probably the most endangered marine mammal inhabiting the region based on the low number of individuals remaining in the population. This species migrates through the region in greatest numbers in the spring and early summer. The fall migration path is not well-known. Calving is believed to occur during the winter. The sei whale is not particularly abundant in the region based on the relatively low number of sightings (CETAP, 1982b). The sperm whale is relatively abundant in the region and generally prefers deepwater habitats (CETAP, 1982b). This species has a four-season distribution along the shelf edge centered about the 1,000-m depth contour and extending seaward of the 2,000-m contour into deeper waters during all seasons. Feeding is thought to occur along the shelf edge and in a rather discrete nearshore area south of Block Island, Martha's Vineyard, and Nantucket Island (inshore of the 100-m contour) from May through November. Calving may take place in late summer or early fall. Blue whales are extremely uncommon in the mid-Atlantic region. It is believed that the remaining population is confined to waters north of the region. In 3 years, the CETAP study recorded only two sightings of this species and these were in waters off Nova Scotia.

#### (7) Estuaries and Wetlands

There are four major estuaries (Narragansett Bay, Raritan Bay, Delaware Bay, and Chesapeake Bay) and many smaller estuarine systems bordering the mid-Atlantic. Approximately 1 million acres of wetlands habitat are associated with these estuaries and portions of the Atlantic coast from North Carolina through Massachusetts (Gusey, 1976). The States with the most extensive coastal wetland-estuarine zone habitat are North Carolina, Virginia, and New Jersey, respectively. The U.S. Department of the Interior's National Estuary Study (1970) determined that the majority of the estuarine systems and coastal wetlands bordering the mid-Atlantic have been moderately or severely modified. The notable exceptions are the eastern end of Long Island, portions of the Gateway National Recreation Area located at the mouth of Raritan Bay, the Great Bay/Mullica River estuary, the lower half of the Chesapeake Bay, and the Outer Banks and Pamlico Sound region of North Carolina. In addition to these relatively unmodified areas, numerous State and Federal wildlife refuges and parks provide protection to valuable coastal wetlands. Approximately two-thirds of the Atlantic's commercially valuable fish and shellfish stocks are estuarine-dependent during some stage of their development. Waterfowl, shorebirds, wading birds, and birds of prey use coastal wetlands for breeding, feeding, migrating, and wintering grounds. A variety of amphibian, reptilian, and mammalian species also are common residents of coastal wetlands.

### (8) Areas of Special Concern

The first designated estuarine sanctuary in the Mid-Atlantic Planning Area is located in Narragansett Bay, Rhode Island. This sanctuary includes Hope Island, Patience Island, the northern end of Prudence Island, and their surrounding waters: a total of 2,629 acres.

The States of Maine, New York, and Maryland have requested acquisition grants provided through the program to establish State sanctuaries. In Maine, the Drake's Island-Laudholm area in the town of Wells is currently being considered. Four natural areas located north of New York City on the Hudson River are proposed for inclusion in a sanctuary including Stockport Flats, Tivoli Bays, Iona Island, and Piermont Marsh. Maryland initially has proposed two sites for an intended multiple site sanctuary to be located in the Chesapeake Bay: the Muddy Creek portion of the Rhode River and Monie Bay in Somerset County.

### (9) Marine Sanctuaries

The U.S.S. Monitor National Marine Sanctuary lies approximately 16 miles southeast of Cape Hatteras in Blocks NI 18-2, 939 and 983. Sites on the site evaluation list include the Virginia/Assateague Island Area due east of Assateague Island.

The area is the site of the historical wreck of the ironclad U.S.S. Monitor. Although this is a fairly high energy area, some attached epifaunal and epifloral species are present. A single colony of the scleractinean coral, *Oculina arbuscula*, has been reported on the wreck, which is apparently its northern limit. The Virginia/Assateague Island site is typical of the inshore areas found in the mid-Atlantic. The fauna is dominated by mollusks, annelids, and the primarily migratory fish that seasonally move through the area.

## c. Socioeconomic Environment

### (1) Employment and Demographic Conditions

The mid-Atlantic coastal region consists of counties and independent cities stretching from Plymouth County, Massachusetts to Carteret County, North Carolina. Although the population in the region declined by 2 percent between 1970 and 1980, the region remains the most populous area in the country with approximately 11 percent of the total U.S. population. Ninety-three percent of the regions's 24.4 million people are concentrated in a series of contiguous metropolitan areas stretching from Massachusetts to Delaware. A second concentration (1.1 million people) is located in the Tidewater, Virginia metropolitan area. The remaining 3 percent of the population is scattered in rural and agricultural areas throughout the region. Population growth and population density vary greatly within the region. Population growth reflects a national trend of large decreases in the inner cities of large metropolitan areas coupled with large increases in the outer suburban counties, and moderate growth in rural areas. Population density in the region ranges from 139,000 per square mile in downtown Manhattan (highest in the nation) to 10 per square mile in Hyde County, North Carolina.

The economy of the region is characterized by a hierarchy of urban centers with highly developed and integrated economies producing for both local consumption and export. In addition, the region contains a small but important agricultural sector. Total employment in the region is approximately 10.6 million or about 10 percent of the total U.S. work force. As with population, employment characteristics vary drastically within the region. The inner areas of the large metropolitan centers are characterized largely by service-based employment. Manufacturing employment in these inner areas accounts for only about 20 percent of total employment (slightly less than the national average). In the outer areas of the metropolitan centers, manufacturing employment is predominant, generally accounting for about 30 percent of total employment (about 40 percent above the national average).

### (2) Coastal Land Uses

Land use in the mid-Atlantic region covers the entire spectrum from fully-developed urban centers and industrial complexes to undisturbed natural areas. Although urbanized areas comprise only about 18 to 10 percent of the total land area, the region accommodates several of the country's largest metropolitan areas. New York, Philadelphia, Baltimore, Washington, D.C., and other cities serve as the nuclei of growth and development. The natural features of the coastal area, its proximity to these major metropolitan areas, and the lure of ocean for sportfishing, boating and beach activities make recreation the single most popular use of the coastline. Beaches are unquestionably a vital recreation attraction, comprising an estimated 60 percent of the shoreline. The largest portion of land in the region, however, is used for farms and pastures, forests, and wetlands. Although still the largest portion of land use, these categories are experiencing steady declines in many areas. For example, in the 15-year period from 1966 to 1981 Long Island (Nassau and Suffolk Counties) experienced reductions in the amounts of vacant and agricultural land and increases in all other land-use categories (Long Island Regional Planning Board, 1982). Delaware, it is estimated, has lost approximately 25,000 acres of tidal wetlands in the past quarter century.

In an effort to control development and manage the growth and composition of an area, land-use planning has long been an integral part of State and, more commonly, local government activity. To this end, numerous State plans and county-wide master plans, municipal land-use plans, zoning ordinances, siting regulations, and other measures have been established. The development of OCS-related facilities would be guided by these measures. It should be stated, however, that facilities such as pipelines, which are considered to be in the national interest, and of regional benefit as well, cannot be arbitrarily excluded by localities and the State.

### (3) Commercial Fisheries

Mid-Atlantic regional catches are reported in two categories by the National Marine Fisheries Service: the mid-Atlantic per se (Delaware, New Jersey, and New York), and the Chesapeake region (Virginia and Maryland).

During 1983, in the designated mid-Atlantic region, approximately 128,023,000 pounds of fish and shellfish were landed with an ex-vessel value of $93,967,000. In terms of dollar value this represents roughly 4 percent of the total U.S. landings. New Jersey contributed 57 percent, New York 41 percent, and Delaware 2 percent of the total commercial fisheries value. Mid-Atlantic landings were dominated by shellfish, which accounted for 68 percent of the total value.

The top ten commercial fisheries, in order of decreasing dollar value are: sea scallop, hard clam, surf clam, ocean quahog, oyster (meat), bay scallop, American lobster, flounder (fluke), tilefish, and scup or porgy. When compared to total species-specific landings data (dollar value), this region accounts for 66 percent of the tilefish, 59 percent of the ocean quahogs, 46 percent of the bay scallops, and 45 percent of the surf clams landed in the nation.

In the Chesapeake region during 1983, approximately 221,198,000 pounds were landed with an ex-vessel value of $102,406,000. This represents 4.4 percent of the total U.S. landings, in terms of dollar value. Maryland and Virginia are nearly equal contributors to the regional value of Chesapeake fisheries. Shellfish also dominate the Chesapeake region, comprising roughly 86 percent of the ex-vessel value.

The top ten commercial fisheries, in terms of decreasing dollar value are: blue crab, sea scallop, oyster (meat), surf clam, flounder (fluke), soft clam, ocean quahog, hard clam, fish (other), and gray seatrout. When compared to total species-specific U.S. landings data (dollar value), this region accounts for 51 percent of the blue crabs, and 46 percent of the surf clams landed.

If the two regions are combined (mid-Atlantic and Chesapeake -- by NMFS classification), the total mid-Atlantic region accounts for 6 percent and 8.4 percent of the total U.S. landings, in terms of volume and value, respectively. The fisheries that contribute the largest proportion of the total U.S. dollar value are: surf clam (91 percent), tilefish (66 percent), ocean quahog (60 percent), and blue crab (51 percent). The Chesapeake region slightly dominates the total regional economy, accounting for approximately 63 and 52 percent of the landings in terms of volume and value, respectively.

Major fishing ports in the total mid-Atlantic region, listed in order of decreasing dockside value are: Cape May-Wildwood (NJ), Hampton Roads area (VA), Ocean City (MD), Greenport (NY), Point Pleasant (NJ), Chincoteague

(VA), Cape Charles-Oyster (VA), and Hampton Bays (NY).

The 1983 mid-Atlantic statistical data (USDOC, 1984) is generally consistent with previous landings data. As detailed in the DEIS for Sale No. 111, shellfish play an important role in the regional economy. The sea scallop, surf clam, blue crab, and ocean quahog fisheries are important within the region and throughout the United States. In general, nearshore fisheries dominate the mid-Atlantic region. In addition to the important shellfish fisheries identified, such nearshore finfish as scup or porgy, gray seatrout, flounder (fluke), and menhaden are harvested extensively in the mid-Atlantic.

### (4) Recreation and Tourism

Barrier islands, commonly less than a mile in width, are the predominant feature of the mid-Atlantic coast. The ocean-facing beaches on these islands are heavily used for recreational purposes. Examples include Fire Island in New York, Long Beach Island in New Jersey, Fenwick Island in Delaware and Maryland, Assateague Island extending from Maryland to Virginia, and Hatteras Island in North Carolina. Other natural features such as estuaries, bays, and inlets create over 15,000 mi of tidal shoreline with pocket beaches, mudflats, marshes, swamps, and dense resort developments. Opportunities are plentiful for such water-dependent recreational activities as swimming, boating, scuba diving, and beach combing. The diversity of natural features also produces a variety of marine and terrestrial resources which are harvested by recreational activities such as hunting and fishing. Wildlife-associated recreation such as bird watching and nature interpretation are also quite popular, engaged in by approximately half of the area's population (FWS, 1980). Examples of other recreational activities which are not dependent upon the shore but enhanced by it include camping and picnicking.

The coastal lands of the region are owned and managed by a variety of Federal, State, and local government agencies and the private sector. The Federal Government, through the Interior Department's National Park Service and the Fish and Wildlife Service, maintains millions of acres of land which are heavily used for recreational activities. The bulk of this activity takes place in national parks, seashores, wildlife refuges, and historic sites.

The private sector also contributes to recreational opportunities in a wide variety of ways. Commercial recreation facilities and resort areas such as Ocean City, Maryland or Rehoboth Beach, Delaware accommodate swelling numbers of summertime vacationers, weekenders, and day trippers. Other privately-owned shorefront areas such as the Hamptons on Long Island constitute vacation home communities. Less developed areas such as the Nature Conservancy holdings on the Delmarva Peninsula are utilized much less intensively for recreation purposes, yet they contribute much to the natural resource base in the region.

The value of coastal recreation amenities is at least partially reflected in an area's tourist industry. Tourism, or travel for the purposes of recreation, is a mainstay of the economy in virtually all the counties along the region's coastline. The effects of tourism can be considerable in terms of employment and personal income as well as municipal and State tax revenues.

The Atlantic coast of Long Island, about 130 mi in length, enjoys an unusually high proportion of publicly-owned lands such as Gateway National Recreation area and Fire Island National Seashore, and several New York State parks. These coastal parks had visitation in excess of 16 milion for 1983 (National Park Service and N.Y. State Office of Parks and Recreation). County and municipal parks and private lands such as the vacation communities in the Hamptons and the shorefront developments of Long Beach, account for the remainder of the coastline. A study of recreation on Long Island (Long Island State Park and Recreation Commission, 1977) estimates that the ocean beach facilities in Brooklyn and Queens experience annual visitation of approximately 32 million, nearly half of which is attributed to Coney Island. Nassau and Suffolk Counties attract an estimated 38 million persons to their south-shore beaches annually. This same study estimated direct shorefront tourism expenditures for Nassau and Suffolk Counties of almost $500 million including beach-related recreation, boating, sports fishing, and club membership. More than half of this amount was for beach activities, more than three quarters of which was attributed to the south shore.

The shore areas of New Jersey serve as a recreation resource for major urban populations of Pennsylvania, New York, and New Jersey. Most of the coast is privately held with large stretches of coast municipally operated as public recreation areas. These beach areas receive very heavy usage. Tourist revenues constitute an important component of the economics of all four coastal counties, and oceanfront recreational resources constitute a vital part of the economy of the entire State. A recent study of New Jersey's recreational resources (NJDEP, 1984) indicates that non-busines visitors to the shore contributed $4.8 billion in direct expenditures in 1982 for recreational goods and services, based on visitation exceeding 77 million person-days. This generated more than $4 billion worth of additional economic activity including 225,000 man-years of employment.

Tourism is virtually the only industry on the Atlantic coast of Delaware and almost all of the coastal shoreline is available for recreational use, including 16 mi public beach. Visitation at the three coastal State parks alone exceeded 2 million persons in 1983. The 2.5-3 mi stretch between Cape Henlopen State Park and Delaware Seashore State Park is the Rehoboth/Dewey Beach area which swells from a population of less than 10 thousand to between 85 and 95 thousand in July and August. Estimates put tourism expenditures at $105 million for this area in 1983 (Rehoboth Chamber of Commerce). Estimates of 1981 travel expenditures for Sussex County (which includes all of Delaware's Atlantic coast) are $136.791 million (U.S. Travel Data Center, 1983).

Similar to Delaware, almost all of Maryland's Atlantic coast is open to recreational use. Assateague State Park and Assateague Island National Seashore (including that portion in Virginia) had a combined visitation of almost 2.5 million persons in 1983 (National Park Service and Maryland Forest and Park Service). The remainder of the Maryland coastline (i.e., Fenwick Island) is intensively developed as a resort area known as Ocean City. With a year-round population of less than 5,000, Ocean City often attracts 125,000 visitors on summer season weekends and up to 200,000 visitors on a holiday weekend such as Memorial Day. Tourist expenditures are estimated at $170 million annually (U.S. Army Corps of Engineers, 1980).

Most of Virginia's Atlantic coast on the Delmarva Peninsula is marshy and relatively inaccessible for recreational use. An exception is the Chincoteague National Wildlife Refuge which occupies the Virginia portion of Assateague Island. The Nature Conservancy owns a number of Atlantic coastal islands (south of Chincoteague) which are managed as wildlife refuges along with several State-owned natural areas. South of the mouth of the Chesapeake, Virginia Beach is one of the most popular tourist destinations in the mid-Atlantic. Travel expenditures exceeded $213 million there in 1982 (U.S. Travel Data Center, 1983).

The Atlantic coast of North Carolina is almost exclusively a barrier island system stretching for over 300 mi. These islands are a mixture of private holdings, wildlife refuges, and parks. Cape Lookout and Cape Hatteras National Seashores combine with several State parks on the coast to accommodate over 3.7 million visitors annually (National Park Service and North Carolina Office of Parks and Recreation). Travel expenditures in North Carolina constitute a major segment of the State's entire economy with tourism ranking as the State's third largest industry. The prominence of the tourist and travel industry is even greater in coastal areas. The estimated 1982 travel expenditures for those counties in the State's coastal zone total $484.7 million (Rulison, 1983).

### (5) Archaeological Resources

It is doubtful that prehistoric man inhabited the continental shelf in the Mid-Atlantic Planning Area from New Jersey south to North Carolina prior to 12,000 YBP, and off Long Island prior to 9,000 YBP. A recent MMS report established that the shorelines for these dates lie presently at an approximate water depth of 30 m. Therefore, the zone of medium-to-high probability of prehistoric site occurrence lies in water depths of 30 m. or less, minus the areas of sand ridges lying adjacent to the coastline. Although shipwrecks are scattered throughout the planning area, the majority of shipwrecks occur in water depths of 60 m. or less.

### (6) Marine Vessel Traffic

The major commercial ports of the mid-Atlantic include New York City; Philadelphia, Pennsylvania; Baltimore, Maryland; and Norfolk, Virginia. On a relative basis, large quantities of crude petroleum are handled only at New York and Philadelphia.

Traffic Separation Schemes (TSSs) and Precautionary Areas have been established by the Coast Guard and adapted by the International Maritime Organization (IMO), a branch of the United Nations, in an effort to reduce the possibility of collisions between vessels entering and exiting major port areas. TSSs and Precautionary Areas have been established in the mid-Atlantic at the approaches to Narragansett Bay, Buzzards Bay, New York Bay, Delaware Bay, and Chesapeake Bay.

### (7) Military Uses

The U.S. Department of Defense (DOD) and the National Aeronautics and and Space Administration (NASA) both use large portions of the mid-Atlantic offshore area. The mid-Atlantic area includes operating areas of the U.S. Atlantic Fleet offshore Norfolk, Virginia and extends north to the Narragansett Bay operating area. These areas encompass vital military activities, such as multi-ship fleet exercises, gunnery and missile events, torpedo firings, anti-submarine warfare operations, and rocket firing events from the NASA Wallops Island Flight Center. (Figure III.A.2.a.6-1).

## 3. South Atlantic

### a. Physical Environment

#### (1) Geology

The South Atlantic Planning Area contains three major sedimentary basins: the Carolina Trough, Southeast Georgia Embayment, and the Blake Plateau Basin. The geology of the South Atlantic is less well known than other Planning Areas mainly because it has the largest number of major basins (3) and the fewest oil and gas exploration wells (7). The industry exploration effort has been concentrated in the Southeast Georgia Embayment, the smallest, and geologically, the least attractive sedimentary basin.

The Carolina Trough is a narrow, linear basin with dimensions of about 280 miles long and 25 miles wide, which contains over 30,000 feet of sedimentary fill. The rocks range in age from Triassic to Recent with most of the section being of Jurassic age. The Carolina Trough has never been drilled, but seismic data indicate that the Triassic rocks are probably continental clastics deposited prior to ocean basin rifting. The Jurassic rocks are probably limestones and dolomites with clastic interbeds. The carbonates either grade landward into clastics or pinch out entirely. The Cretaceous and younger sediments are believed to be mostly sand and shale with carbonates occurring as a second order component in clastic rocks, e.g. marls, calcareous mudstones.

The Blake Plateau Basin is really the largest sedimentary basin off the U.S. east coast. There are no deep exploratory wells in the basin but speculations regarding the probable lithologies have been made. Most of the basin is probably floored by transitional basement generated during the rifting process. Sediments above basement are mostly limestones and dolomites, which are over 30,000 feet thick in the axis of the basin. Well over half of the total thickness is Jurassic in age with most of the remainder being Cretaceous. Basin subsidence had apparently ceased by the close of the Cretaceous period, since the Tertiary section is extremely thin. The surface of the Blake Plateau is presently swept by strong bottom currents that prevent further deposition.

#### (2) Geologic Hazards

Geologic features hazardous to drilling are sparse in the shallow water areas of the South Atlantic. The lack of a steep, canyon-incised slope and the low sedimentation rate in much of the shallow area, due to the Gulf Stream sweeping the seafloor clean, eliminates much of the sedimentary environment in which geohazards are most often found. Hazards that do exist in the South Atlantic are: surficial sediment collapse into cavernous (karst) topography, sediment mass movement, shallow gas, and active faults. The collapse of surficial sediments has been observed on the shelf of northern Florida and Georgia in places where portions of shallow carbonate rocks have dissolved, leaving the surficial sediments without support. Similar conditions exist on the Blake Plateau where the presence of shallow karstic carbonates could result in surface collapse. With the ubiquity of carbonates in the South Atlantic, there is the possibility that surficial sediment collapse may be a problem in other areas as well as those just mentioned. Hazards are more common in the deepwater portion of the South Atlantic. Sediment mass movement has been noted on the continental slope particularly between 31° N and 35° N latitude. Those mass movements appear to be fairly recent. The potential for shallow gas is highest on the slope and upper rise of the eastern Blake Plateau and Carolina Trough where clathrate (frozen gas hydrate) layers can act as caps, forming shallow gas pockets. In addition, a major growth fault which appears to be presently active also occurs along the eastern edge of the Carolina Trough and Blake Plateau.

Of the various constraints to drilling found in the South Atlantic (i.e., scour, shallow buried faults, filled channels, and gassy sediments), the most notable is scour. Cape-associated shoals are highly mobile, and areas of the outer shelf, slope, and Blake Plateau are intensly eroded by the Gulf Stream and associated currents. Shallow faults are common in the South Atlantic. These can act as conduits for over-pressured gas if the two features occurred in conjunction with each other.

### (3) Non-Petroleum Mineral Resources

The South Atlantic Planning Area holds a rich variety of non-energy minerals. Major non-energy minerals found here are sand, gravel, phosphorites, manganese oxides and placer deposits of heavy minerals (e.g. gold, platinum, ilmenite, staurolite, rutile, etc.). Sand can be found in many areas where waves or paleo-rivers winnowed the fine materials out, leaving behind the sands. These winnowed deposits are also prime sites to find heavy minerals. The same forces which concentrate the sands also tend to concentrate the heavy minerals. While phosphorites are not as ubiquitous as sand deposits, they occur offshore of all of the south Atlantic states and on the Blake Plateau with much of it near or on the surface. Manganese oxides occur on the Blake Plateau as nodules and in pavements.

Presently there is no offshore mining in the south Atlantic, however, as the populated areas deplete their onshore sources of building aggregate, the continental shelf will become a major supplier. The association of heavy minerals with sand and gravel deposits enhances the value as two resources can be exploited essentially for the price of one. The high platinum content of Blake Plateau nodules makes them good sources of catalyst material. This fact plus the steadily dwindling supply of phosphorus, tight supplies of titanium and platinum, and the increasing need for sand and gravel could mean offshore mining not too many years in the future.

### (4) Oceanography

#### (a) Chemical

The South Atlantic area includes primarily waters of the Gulf Stream and the Continental Shelf. There is an interaction between these waters whereby the Gulf Stream, through its meanderings and intrusions, substantially influences the physical as well as the chemical character of the shallower shelf waters. In the Gulf Stream, which is an area of steeply inclined isotherms, the concentrations of principal nutrients (phosphate, nitrate, and silicate) increase nearly linearly in proportion to decreasing temperatures. Upwelling (intrusion) of the deeper, nutrient-rich water at the western boundary of the Gulf Stream is considered to be the major source of nutrients on the outer region of the South Atlantic OCS and occurs throughout the year. Salinity in shelf waters is highly dependent on the proximity of the Gulf Stream. In general, salinity increases in a seaward direction to the 36 ppt characteristic of Gulf Stream waters. Within the South Atlantic, dissolved oxygen is high, decreasing from north to south and seaward. Values as high as 11.5 mg/l over the shelf in winter decrease to about 4.5 mg/l at 300 meter depth (fully in Gulf Stream waters), during the summer.

### (b) Physical

Whereas in the Mid- and North Atlantic Planning Areas there exists a transition zone between the shelf and Gulf Stream waters, in the South Atlantic Planning Area such a zone does not exist. The Gulf Stream is adjacent to shelf waters, greatly influencing the oceanography of the area. Intrusions of the Stream (in this case filaments) impinge upon the shelf on a regular basis. The shelf's circulation is not a well defined pattern, being influenced primarily by the proximity of the Gulf Stream western boundary.

Cyclones and hurricanes are a major concern here with the vicinity of Cape Hatteras, North Carolina being particularly vulnerable to these storms. Also of great concern for OCS operations are the high speeds of the Gulf Stream -- more than 4 kt in some instances.

### (5) Water Quality

Generally, water quality in the South Atlantic appears to be good. Results of a 1977 South Atlantic OCS Benchmark Program (TI, 1971) conducted in the Georgia Bight, as well as other available background data, have shown little evidence of petroleum contamination in the South Atlantic. Little or no petroleum hydrocarbons were detected in water, sediment, and biota samples. Concentrations of the trace metals cadmium, cobalt, nickel, zinc, and mercury reported for continental shelf and surface waters off the southeast Atlantic coast (Windom and Smith, 1972; Windom, 1973) did not exceed concentrations normally found in seawater. Suspended particle load, and in turn turbidity, generally decreases seaward from the south Atlantic coast toward the Gulf Stream waters. Elevated levels of suspended particles noted in offshore locations during the winter and spring appear related to storms and/or the impingement of the Gulf Stream on the outer shelf. Except for coastal disposal of dredged materials, which results in temporary degradation of local water quality, no other materials are presently being dumped in the South Atlantic.

### (6) Ocean Dumping

Dredged materials are the only materials presently being dumped in the South Atlantic. Thirteen active, dredged materials dumpsites are located nearshore (usually less than 5 nautical miles from shore) along the South Atlantic coast (40 CFR 228.12, July 1, 1984). Except for the Jacksonville Harbor (Florida) Site which was designated "final" (Federal Register, June 14, 1984), the other dredged materials sites have an "approved interim" status, meaning that environmental studies for determining impact and continued use have not been completed by the U.S. Environmental Protection Agency. (Figure III.A.3.a.6-1).

Also scattered throughout the South Atlantic area are former sites, presently inactive, used for dumping of undetonated explosives (e.g., bombs, mines, munitions) --4 major sites; chemical munitions (e.g., rocket fuel) --1 major site; and low-level radioactive materials (e.g., contaminated gloves and tools) encased usually in steel drums --approximately 15 sites (U.S. EPA, 1980; NRC, 1981; Smith and Brown, 1971; 1983 NOAA Navigational Chart 1109). Locations of the undetonated explosives, chemical munitions, and especially the radioactive materials dumpsites, are only approximately known because of incomplete records.

### (7) Climate

The average monthly wind speeds do not demonstrate an appreciable difference among seasons. The velocities range from approximately 8 knots in the summer to 10 knots in the winter. The wind velocities tend to increase in a northerly direction as the weather patterns start to blend in with those of the mid-Atlantic area--which generally have higher winds--in the vicinity of Cape Hatteras. Inshore winter temperatures range between 7° C at Cape Hatteras to about 16° C at Cape Canaveral and increase seaward as the influence of the Gulf Stream increases. Summer temperatures increase to approximately 27° C.

The region encompassed in the planning area is one of active cyclogenesis. Tropical storms (cyclones) have wind speeds between 34 and 63 knots, however these storms may develop into hurricanes (wind velocity > 63 knots) with their associated high waves and destructive forces. The probability of a hurricane intercepting land during a one year period ranges from approximately 6 percent to 12 percent from Cape Canaveral to Cape Hatteras. The probability that a hurricane may enter the planning area is expected to be slightly higher. Extratropical storms may occur in the area during any month, but are more common during late fall, winter, and early spring. Because of the relatively greater distance the winds from these storms travel over the sea surface (fetch), higher waves are typically more associated with these storms than hurricanes.

### (8) Air Quality

Air quality conditions within each State are determined by existing levels of specified pollutants. These pollutants, for which the U.S. Environmental Protection Agency (EPA) has established primary and secondary National Ambient Air Quality Standards are sulfur dioxide (SO2), nitrogen dioxide (NO2), carbon monoxide (CO), ozone (O3), total suspended particulates (TSP), and lead. Primary standards are intended to protect public welfare, including esthetic values. The 1977 Clean Air Act

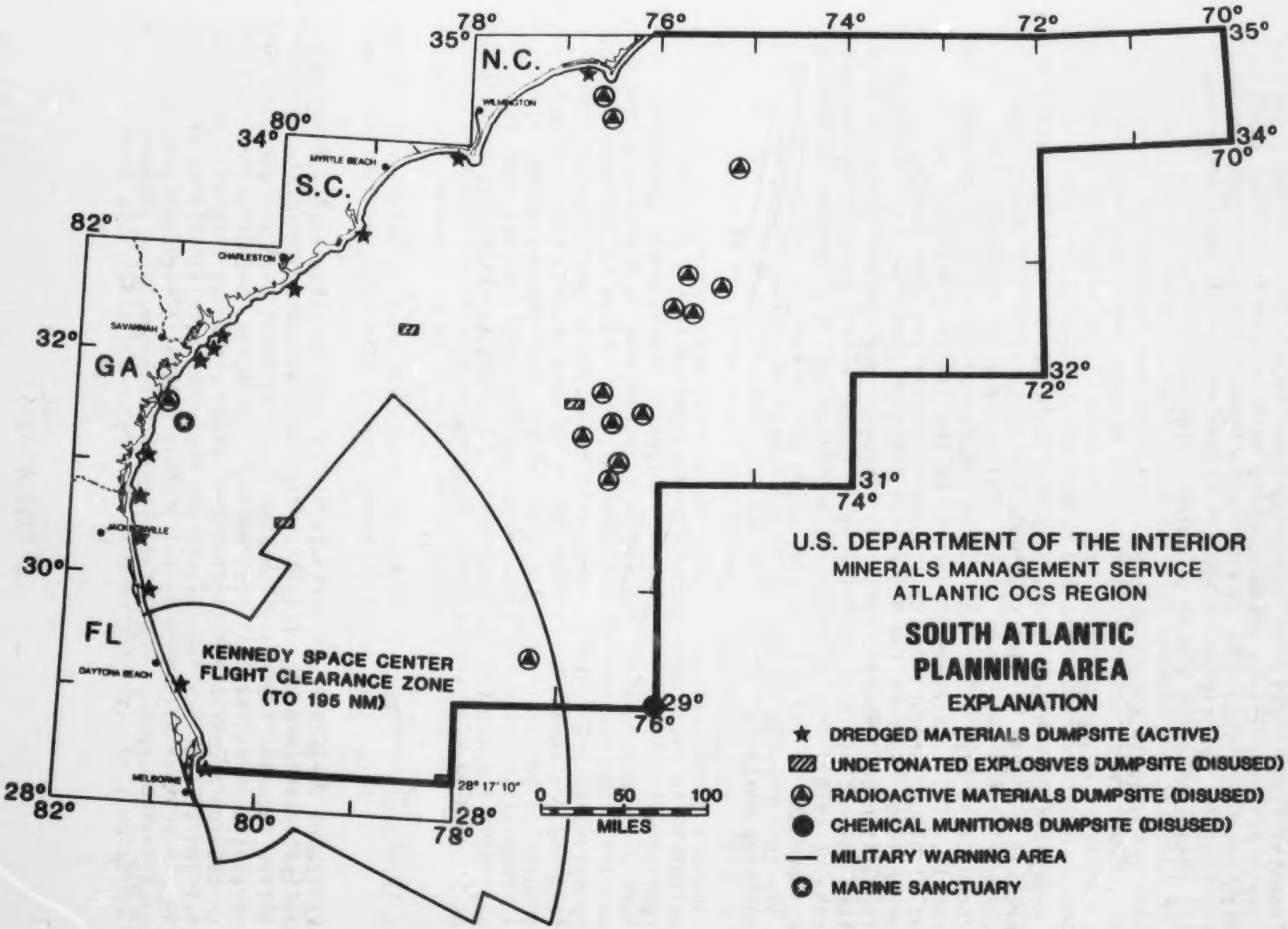


Figure III.A.3.a.6-1. Dumpsites, Military Areas, and Marine Sanctuaries in the South Atlantic Planning Area.

READEX FICHE

Amendments require all areas of the country to be categorized according to their NAAQS attainment/non-attainment status for the specified pollutants. Also, States have been required to submit to the EPA for approval State Implemental Plans (SIPs) for attaining compliance with the NAAQS. Each of the South Atlantic states where on-shore sale-related facilities could be located have submitted SIPs to EPA. Only Florida and South Carolina presently contain non-attainment areas. These are for TSP and O3 with the latter pollutant being a more widespread problem.

### b. Biological Environment

#### (1) Plankton

The South Atlantic Bight is dominated by two water masses -- the shelf waters and the Gulf Stream -- which align parallel to the shelf. The major components of the phytoplankton are diatoms, coccolithophores, and pyrrhophyceans with silicoflagellates and cyanophyceans as minor components (Marshall, 1971). Nitrate appears to be the limiting nutrient and the areas of higher production (cell number-biomass) are near sources of riverine input (Hulbert and MacKenzie, 1971) or upwelling areas. Total phytoplankton cell numbers generally decrease in a seaward direction with diatoms dominating throughout the water column within 50 miles of the coast (Marshall, 1976). Coccolithophores and dinoflagellates become relatively more important in the Gulf Stream, where diatom numbers sharply decrease and are concentrated in the top 75 m of water (Marshall, 1969, 1971; Hulbert and McKenzie, 1971).

The inshore concentrations of zooplankton have been reported up to 3,499 organisms/m3 in the summer and 1,000 organisms/m3 in the winter, but decreasing with distance from shore. Copepods dominate the community inshore and coelenterates, chaetognaths, euphausids, and pteropods are numerically important offshore (Roberts, 1974). Fahay (1975) reported that ichthyoplankton are found year-round in the South Atlantic region. The surface neuston community is reported to be more diverse than the subsurface water column, but the neuston contained lower concentrations of organisms (Powles and Stender, 1976). The authors also reported that large numbers of a species may be captured at a few neuston stations, which indicates a contagious distribution for some species.

#### (2) Benthos

##### (a) Intertidal

There are no large natural outcroppings of rock or other hard substrates along this portion of the Atlantic coast such as one finds in the north Atlantic. However there are isolated rocks or shell beds and man-made hard substrates such as rock jetties, pilings, sea walls, wooden groins, etc., which develop a characteristic fauna of sessile species that also occur on oyster reefs. Various free-living and commensal species find suitable conditions for their existence as well. This community includes grazing herbivores, filter-feeders, detritus feeders, scavengers, and predators.

Faunal zonation is an obvious feature of intertidal hard substrates. This zonation is a function of the degree of exposure to air with the many parameters this implies, including temperature extremes, dessication, wave action, etc. The supralittoral fringe is dominated by the barnacle *Chthamalis fragilis* and the isopod *Ligia exotica*. A zone dominated by barnacles of the genus *Balanus* occurs in the upper intertidal zone, grading into an assemblage of various sessile molluscs in the lower intertidal and subtidal levels. Many tubiculous polychaetes occupy portions of the intertidal and subtidal levels. Within the crevices between the attached fauna occur errant polychaetes and amphipods. Stephenson and Stephenson (1952) in a classic paper described several such communities from Cape Lookout, North Carolina to St. Augustine, Florida with special reference to zonation. Zonation is similar throughout the region but some species common in one area are absent in others which are outside of their geographic range. For example, the barnacle, *Tetraclita squamosa*, and the limpets, *Littorina ziczac* and *Siphonaria pectinata*, occur in Florida and Georgia (Kraeuter 1973) but not further north. *Littorina irrorata*, the salt marsh periwinkle, is accidental in this habitat.

Most species in this assemblage have planktonic larvae which allow them to invade new habitats rapidly. The specific assemblage which will develop in a given location is a function of salinity, temperature regime, degree of air exposure, and nature of the substrate (wood, rock, concrete, etc.).

Kirtley and Tanner (1968) reported sabellariid reefs along the coast of Florida. North of Cape Canaveral, these reefs are formed by *Sabellaria vulgaris*; south of the Cape, reefs are formed by *Phragmatopoma lapidosa*.

Throughout much of the area there are natural and man-made oyster reefs with commercial significance. These reefs are predominantly intertidal in high salinity waters in the low parts of estuaries (Wells and Gray 1960). The major commercial oyster reefs are subtidal in lower salinity waters. Two major factors which regulate subtidal distribution of oysters are larval setting behavior as a function of hydrographic and physical conditions, and the salinity tolerance of oyster predators. Most predators are subtidal and have limited capabilities to penetrate the estuary (compared to *Crassostrea virginica*). Hence the oyster is restricted to the intertidal zone by the negative effects of predators in high salinity waters (literature reviewed in Wells 1961; Wells and Gray 1960).

Oysters developing on hard substrates scattered over soft bottoms will gradually convert the area into a firm substrate.

Soft intertidal or just subtidal substrates lacking vegetation and found in relatively sheltered waters along the mid-Atlantic and southeastern states provide a habitat for invertebrate infauna. Such communities are generally subjected to pronounced gradients of environmental conditions including salinity, temperature, tidal influence and substrate type (Gray 1969). Salinities depend not only upon tidal state, but also on varying amounts of rainfall and groundwater seepage. Similarly, a wide annual range of temperature occurs in the shallow waters of this coast. Thus, permanent residents of most such flats are eurythermal and euryhaline. Gray noted that the tide governs water exchange and determines the extent and time that a flat may be exposed, if intertidal. Current strength influences the type of sediment present and the character of the substrate is a determining factor in the types of animals inhabiting it.

The fauna of these flats includes species burrowing into the sediments (infauna), species attached to the scarce solid substrates (driftwood, shell, etc.), species crawling over the substrate and various commensal species. Most species are detritus feeders, but filter feeders and scavengers are also common.

### (b) Subtidal

The benthic environment in the South Atlantic can be divided into two basic substrate types -- soft or hard bottom. Because of the less complex, more planar aspect of the soft bottom, fewer niches are available and the species diversity and abundance are lower. The soft-bottom areas are predominantly inhabited by infaunal organisms, with the more motile infaunal predators moving over these areas. The hard-bottom areas are more three-dimensionally complex and provide more niche space than the soft-bottom areas. The hard bottoms also provide attachment substrate for epifaunal organisms, which increases the complexity of the areas. Werner et. al. (1983) reported than Annelida and Mollusca were the most represented groups in hard-bottom areas with 261 and 203 taxa, respectively. The authors also reported that annelids were numerically dominant in suction-and-grab samples, making up 64.7 percent of all individuals captured. Amphipods were second and comprised 17.4 percent of all organisms, by number, in suction-and-grab samples.

Tenore (1979) reported that no north-south trends within the South Atlantic Bight were demonstrated for density, biomass, or total number of species by the macro-infauna. He noted that the slope area was generally depauperate and less diverse than the shelf, and attributed depth, and not latitude, as being the main factor for community delineation.

Oculina varicosa is a unique scleractinian coral which occurs in a limited area off the coast of Florida. The area of major occurrence is approximately 17 to 25 miles offshore in 70 to 100 m of water and is delineated by the coordinates 27°30'N to 28°35'N and 79°56'W to 80°02'W. These coordinates encompass an area of 390 square nautical miles (65 nmi x 6 nmi). O. varicosa forms monospecific thickets and banks with a relief of up to 25 m. As noted by Reed (1981) Oculina banks are unique areas which provide habitats for many species, some of which have not been described yet. The O. varicosa banks in the area delineated above are the only known thickets of monospecific colonial coral that occur on the Continental Shelf in the United States. Individual colonies have been reported off North Carolina and on the U.S.S. Monitor (Reed, 1980). As with other complex environments, O. varicosa banks have a large and diverse fauna associated with them. Reed (1981) notes that 23 families of polychaetes, 200 species of mollusks, 50 species of amphipods, and 20 species of echinoderms have been reported from Oculina areas, and that this fauna helps support a dense population of reef fish. The author also states that the O. varicosa banks are important breeding, nursery, and feeding areas for many commercial fish species.

### (3) Fish Resources

The fish resources of the south Atlantic can best be described by reference to water depth. As the distance from shore increases, bottom substrate type changes, and the influence of the Gulf Stream becomes more pronounced. Four groupings within the south Atlantic region provide a general overview of the finfish and shellfish of the region. In addition, species-specific information for selected south Atlantic species is contained in Appendix G of the FEIS for Sale No. 90.

Nearshore, year-round inhabitants include such species as pink and white shrimp, blue crab, spotted seatrout, black drum, and southern kingfish. These species demonstrate limited movements between upper and lower portions of estuaries, bays, and sounds and coastal environments of water depths less than 20 m. In general, they occur on soft-bottom sediments, or in association with algae or attached vegetation. These organisms are tolerant of a wide range of salinities, temperatures, and oxygen levels.

Nearshore inhabitants that spawn offshore include such species as brown shrimp, menhaden, croaker, spot, summer flounder, and striped mullet. This group differs from the first in that it spawns offshore in water depths between 20 and 200 m. Spawning activity peaks during winter months, followed by a return migration to nearshore waters for the rest of the year. These species are also tolerant of a wide range of salinities, temperatures, and oxygen levels.

Outer shelf and shelf-edge live-bottom inhabitants include species in association with hard-bottom substrates and often demonstrates an affinity for rock outcroppings, wrecks, coral growths, sponges, and other bottom anomalies which are utilized for feeding and orientation. They can generally be categorized as belonging to the snapper-grouper complex, which is described in detail in the FEIS for Sale No. 90. Many species, such as triggerfish and red porgy, are well adapted to specific feeding strategies on or near hard-bottom habitats, and little overlap in feeding preference occurs. These foraging species are consumed by live-bottom upper level predators such as warsaw and gag grouper.

Ocean pelagics are often referred to as the "blue water" species, because of its association with the Gulf Stream. Species within this grouping often migrate from southerly portions of the South Atlantic Bight to as far north as Georges Bank and the Gulf of Maine. Species often associated with this assemblage include dolphin, yellowfin tuna, little tunny, sailfish, swordfish, and white marlin.

In addition to these groupings, there exists a deepwater assemblage of fish which is similar to that described in the north and mid-Atlantic regions. Prinicipal species include lanternfish, anglerfish, rattails, grenadiers, blue hake, and some deep-sea eels.

### (4) Marine Mammals

There are approximately 32 species of marine mammals (including manatees, whales, dolphins, and porpoises) occuring in the South Atlantic region ranging from common to very rare. The distribution, typical habitat, and population estimate for each of these species is summarized in FEIS Sale No. 90.

In addition to these marine mammals, there are 3 species of seals which have been sighted in the region but are considered to be only accidental visitors to the South Atlantic area. They are the harbor seal, hooded seal, and the California sea lion. Of the species inhabiting the region, approximately 22 can be encountered in the waters of the South Atlantic on a regular basis. Seven of these species are on the Federal list of endangered species.

The remaining non-endangered cetaceans in the South Atlantic region are predominantly the smaller, toothed (ondontocete) whales and dolphins. The most abundant species include, based on sightings and strandings in the region, the spotted and bottlenosed dolphins, the short-finned pilot whale, and the pygmy sperm whale, (Schmidly, 1981; Winn et al., 1979). In general, information on the life history of many of these species is limited and the importance of the South Atlantic region is not well known. However, it appears that the most abundant species have a wide distribution throughout the region, but some species like the bottlenosed dolphin, have distinct nearshore and offshore sub-populations. Feeding, breeding, and calving activities are thought to occur to some degree throughout the region. A limited migration or seasonal shift in distribution probably occurs for most species with animals moving to the northern portion of the region in the spring and summer and returning south in the fall and winter. Most species are present within the area at all times of the year.

### (5) Coastal and Marine Birds

The South Atlantic region is used by pelagic species primarily as a feeding ground or during migratory periods with their breeding grounds located outside the region (Clapp et al., 1982a). When feeding, pelagic species tend to concentrate in nutrient-rich upwelling areas. The waters off Cape Hatteras, NC, along the western edge of the Gulf Stream, are known to be an important feeding area for several species (Lee and Booth, 1979). Although migratory periods vary according to species, the largest numbers and greatest concentrations of migrating pelagic birds occur from approximately May to September as Wilson's Storm petrel and Cory's shearwater overwinter in the region during this time.

Shorebirds are a closely related group of species that are represented in the South Atlantic by oystercatchers, plovers, sandpipers, turnstones, and phalaropes. Approximately 23 species occur annually in each coastal State. Shorebirds are found in most marine, estuarine, and palustrine habitats where they feed primarily upon aquatic invertebrates. They utilize these coastal areas in the South Atlantic during their northern spring migration and southern fall migration which actually begins in late summer for most species. Some birds overwinter in the region. Shorebirds tend to be more broadly distributed along the Georgia and Florida coasts, possibly as a function of the barrier islands, long unbroken beaches, and climatic conditions (Gusey, 1981).

Wading birds are waterbirds that typically have long legs and necks with small bodies. Principal species include the herons, egrets, ibises, and bitterns. Wading birds feed in shallow water in marine and estuarine intertidal areas in every State bordering the South Atlantic. Approximately 14 of the 15 species which commonly occur in the area are known to breed in the South Atlantic region (Wass, 1974). Nesting occurs in every State with Florida supporting the largest number of nesting colonies.

### (6) Endangered and Threatened Species

The bald eagle (*Haliaeetus leucocephalus*) is an endangered species that is native to the Atlantic coastal zone. In the South Atlantic region, the greatest concentration of breeding pairs occurs along the banks of the St. Johns River in northern Florida (Hynson, 1977) and in the Everglades in southern Florida.

There are two subspecies of the peregrine falcon found in the region: the endangered American peregrine (*Falco peregrinus anatum*) and the threatened Arctic peregrine (*F. p. tundrius*).

The brown pelican (*Pelecanus occidentalis*) is an endangered marine bird that occurs in the South Atlantic region. This species is a colonial nester that utilizes relatively undisturbed coastal islands in salt and brackish waters to feed and rear their young. This bird feeds by diving for its prey. Portnoy *et al*. (1981) identified 21 brown pelican colonies between North Carolina and Key West, Florida.

The cahow or Bermuda petrel (*Pterodroma cahow*) is an endangered seabird which inhabits and nests in Bermuda and its surrounding waters, but has been observed off the Carolina Capes following West Indian hurricanes (Murphy, 1967). The total population is believed to number around 120 individuals including approximately 30 breeding pairs (Dr. David Lee, NC State Museum of Natural History, Personal communication).

The wood stork (*Mycteria americana*) is an endangered wading bird. It is the only species of true stork breeding in the United States. Wood storks frequent freshwater and brackish wetlands, feeding primarily on small fishes. A number of wood stork rookeries are found along the Atlantic coast of Florida and Georgia.

Five species of sea turtles occur in the waters of the South Atlantic region. The hawksbill (*Eretmochelys imbricata*), the leatherback (*Dermochelys coriacea*), and the Atlantic ridley (*Lepidochelys kempi*) are currently listed as endangered.

The green sea turtle (Chelonia mydas) is listed as threatened throughout the South Atlantic region except in the coastal waters of Florida where it is listed as endangered. The loggerhead (Caretta caretta) is listed as a threatened species.

The loggerhead is the major breeding species in the region. Nesting beaches have been recorded as far north as New Jersey, but tend to be concentrated from South Carolina through Florida. Major nesting beaches include Cape Romain, South Carolina; the Cumberland Island area, Georgia; and Merritt and Hutchinson Islands, in Florida. In 1980, the U.S. Fish and Wildlife Service located 1,191 loggerhead nests on Cape Romain National Wildlife Refuge and 1,104 nests on Hobe Sound National Wildlife Refuge which is adjacent to Hutchinson Island, Florida.

The principal breeding grounds for the green turtle in the western hemisphere are located in Central and South America but a small breeding population nests on Florida's east coast. Nesting is confined primarily to the coastline between Brevard and Broward Counties. In 1980, the U.S. Fish and Wildlife Service located 17 green turtle nests on Merritt Island National Wildlife Refuge and 23 nests on Hobe Sound National Wildlife Refuge. Nesting also occurs on Hutchinson Island.

The leatherneck is primarily a carnivorous, highly migratory, pelagic turtle that rarely enters shallow coastal waters. Results from an MMS-funded study in the adjacent North and Mid-Atlantic regions (CETAP, 1982) suggest that leatherback turtles may concentrate in the Gulf Stream during migratory periods in order to carry them to feeding grounds at higher latitudes. The principal breeding grounds of this turtle are restricted to tropical beaches lying between the latitudes of 20° N and 20° S (Carr, 1977); however, a limited amount of nesting occurs on the east coast of Florida. Carr and Carr (1977) have estimated that between 15 and 30 females nest annually on Florida's beaches.

The ridley does not nest in any of the South Atlantic States. The only major nesting beach left in the world for this species occurs along a small stretch of Mexican beach along the Gulf of Mexico in the State of Tamaulipas.

The hawksbill is probably the most infrequently occurring sea turtle in the South Atlantic region. Hawksbill nests in the South Atlantic region are extremely rare (approximately 3 since 1959).

The life history of young, posthatchling sea turtles is poorly known but it is probably a period of critical importance to the survival of each species of turtle. Witham (1980) refers to this life stage as the "lost year" and suggests that it is a period of oceanic existence when turtles opportunistically use oceanic currents and food sources for dispersal and survival. If this is the case, then the South Atlantic region would be particularly important as a nursery area for endangered or threatened sea turtles, as the loggerhead, green, and leatherback turtles all nest in the region.

There are seven species of endangered marine mammals occurring in the South Atlantic region. They are the West Indian manatee (Trichechus manatus), blue whale (Balaenoptera musculus), fin whale (B. physalus), sei whale (B. borealis), humpback whale (Megaptera novaengliae), right whale (Eubalaena glacialis), and sperm whale (Physeter catodon).

The manatee occurs primarily in the coastal and inland waterways of Florida particularly during the winter season. During the warmer summer months, manatees will migrate northward traveling in shallow coastal waters; however, sightings north of Georgia are unusual (National Fish and Wildlife Laboratory, 1980b). A significant amount of preferred habitat in Florida has been officially designated as critical habitat for the manatee.

The blue and sei whales are very uncommon in the region as these species generally are considered to prefer colder, more northern waters. Schmidly (1981) has listed only two recorded strandings of sei whales in the region and no recorded strandings of blue whales. The fin whale is more abundant than either the blue or sei whale, but it is still considered to be rather uncommon in the waters of the South Atlantic. Schmidly (1981) has listed 11 recorded strandings and one recorded sighting of fin whales in the South Atlantic region.

The humpback whale probably migrates through the South Atlantic region in the early spring heading for summer feeding grounds north of Cape Cod and returns in the late fall on its way to breeding grounds in the Caribbean. The right whale is the most endangered whale occurring in the South Atlantic region. This species is present in the area during the late fall, winter, and early spring seasons. Recently, it has become apparent that the South Atlantic region is a calving ground for right whales based on aerial sightings and beach strandings.

The sperm whale is the most abundant endangered whale occurring in the South Atlantic region. Schmidly (1981) has listed numerous records of sightings and strandings in the region. Sperm whales are generally found in deeper offshore waters where they actively feed all year-round.

### (7) Estuaries and Wetlands

In the South Atlantic, estuaries are considered to exist at the mouth of every major river and sound emptying into the Atlantic Ocean. North Carolina's Currituck, Albermarle, and Pamlico Sounds together constitute the largest estuarine system along the entire Atlantic coast. A unique feature of these sounds is that they are partially enclosed and protected by a chain of fringing islands, called the Outer Banks, some 20 to 30 miles from the mainland (Warinner *et al*., 1976). Estuaries to the south of North Carolina lack a similar chain of fringing islands and are therefore less protected and more exposed to the open ocean.

Salt marshes are typically intertidal beds of rooted vegetation that border the margins of estuaries, protected bays, and the landward side of barrier islands. Extensive stands of salt marsh with deep tidal channels are found south of Cape Lookout, North Carolina, through South Carolina and Georgia.

Almost three-quarters of the salt marsh acreage along the Atlantic seaboard is found in these three States. The largest areas of salt marsh on the South Atlantic coast are in Georgia (about 477,000 acres) followed by South Carolina (about 435,000 acres) and North Carolina (about 158,000 acres) (West, 1977). For northeast Florida, the St. John's and Nassau River systems include large areas of salt marsh. In recognition of the importance of salt marshes to fish and wildlife, 17 Federal and numerous State and private wildlife refuges, game lands, and parks have been established in the coastal zone of the South Atlantic region.

### (8) Areas of Special Concern

Sapelo Island, Georgia, is a barrier island that has been designated a National Estuarine Sanctuary. Adjacent to Sapelo Island is Blackbeard Island National Wildlife Refuge. Together, these barrier islands form an especially valuable coastal preserve for a variety of fish and wildlife and their habitats. North Carolina has recently designated a three-part estuarine sanctuary to preserve over 3,500 acres of island, marsh, intertidal flats, and shallow estuarine habitats along its coast.

Mangrove swamps provide valuable nesting and feeding areas for a variety of birds, including the endangered brown pelican, and also serve as nursery grounds for commercially important fin and shellfish species such as tarpon, snapper, oysters, and crabs. The mangrove swamp ecosystem has a very limited range along the U.S. southeast coast. The northern extremity of these swamps occurs as far as 30° N latitude on Florida's east coast (Odum et al., 1982). Shaw and Fredine (1971) have reported swamps of approximately 25,000 acres in the Cape Canaveral area. However, additional mangrove swamps are restricted to the southern extremity of Florida, primarily in Dade County on the east coast and in Lee, Collier, and Monroe Counties on the west coast (Odum et al., 1982).

### (9) Marine Sanctuaries

Gray's Reef encompasses 6 blocks and covers an area of 34,159 acres (13,824 hectares). This area includes blocks containing Gray's Reef National Marine Sanctuary which lies 17.6 nmi east of Sapelo Island, Georgia.

The sanctuary is a biologically productive, moderate-high relief, live-bottom reef. The reef supports a variety of biota including an array of seaweeds, invertebrates, fish and turtles. The sanctuary demonstrates the subtropical community profile which is common to live-bottom areas in the south Atlantic, and is a valuable research area for the study of reef environments.

## c. Socioeconomic Environment

### (1) Employment and Demographic Conditions

A very uneven distribution of population is characteristic of the South Atlantic coastal region. As a general rule localities with a large population either contain a major port or are resort-retirement centers. Largely because of the presence of numerous wetlands and a lack of basic infrastructure, coastal Georgia and the Albermarle-Pamlico Sound areas of North Carolina are the most sparsely populated portions of the region. Southern Florida, on the other hand, is the region's most heavily populated area, containing approximately half of the region's total population.

Between 1970 and 1980 the South Atlantic coastal region's population increased by 32 percent. Every county and city, with the exception of Norfolk, Virginia, experienced an increase in population. The overwhelming majority (92 percent) of the region's population growth, however, occurred in the region's metropolitan areas.

Historically the South Atlantic coastal region has been a depressed region lagging behind many parts of the country in terms of overall economic development. In recent years, however, the region has made great progress as dependence on agriculture has been replaced by growth in the manufacturing and service sectors. An indication of this can be seen in the area's employment growth. Between 1976 and 1982, 31 of the 40 counties and cities in the region experienced employment growth greater than the national average. In fact, half of the counties and cities in the region experienced employment growth of more than double the national average.

Still the South Atlantic area in general and the coastal region in particular lag well behind the nation in other economic indicators. Of the 40 counties and cities in the region, only 7 percent reported per capita income greater than the national average, while 15 percent reported per capita income less than 75 percent of the national average. Of the 40 counties and cities in the region, only 8 reported the percentage of families living below the poverty level lower than the national average, while 17 reported the percentage of families living below the poverty level 1.5 times the national average.

### (2) Coastal Land Uses

The coastal area of the south Atlantic includes barrier islands, sea islands, inland water bodies, and estuaries, creating over thousands of miles of tidal shoreline and hundreds of thousands of acres of marshland. This diversity of natural features produces a variety of marine and terrestrial resources. The coastal lands of the south Atlantic are owned and managed by a variety of Federal, State and local government angencies and the private sector and they include a wide variety of uses, ranging from undisturbed wooded areas and marshlands to intensively developed resort complexes.

The coastal area from Cape Henry, Virginia to the North Carolina - South Carolina border is predominantly rural in character with forest land constituting the largest land use. Major urban areas include the Hampton Roads area in Virginia and Wilmington, N.C. Coastal South Carolina and Georgia are also predominantly rural in character with the vast majority of land devoted to agriculture and forestry. Major tourist industries are centered around Myrtle Beach and Hilton Head, S.C. Large metropolitan areas include Charleston, S.C. and Savannah, GA. Smaller urban areas include Georgetown, S.C. and Brunswick, GA. Florida's coastal area has experienced very rapid growth in the past two decades with commensurate land use pressures. The transition from an agricultural economy to an urban/tourism economy has resulted in widespread consumption of land for housing and industry. Land use development pressures are expected to continue.

### (3) Commercial Fisheries

The south Atlantic region is comprised of the States of North Carolina, Georgia, South Carolina, and Florida (east coast). In 1983, 397,324,000 pounds of finfish and shellfish were landed, with an ex-vessel value of $172,587,000 (USDOC 1984). This represents 7.4 percent of the total U.S. landings, in terms of dollar value. North Carolina is the single largest contributor (35 percent of the region), with Florida (34 percent) contributing nearly the same amount, and Georgia (15.5 percent) and South Carolina (15.4 percent) contributing nearly equal portions of the remainder. South Atlantic fisheries were dominated by shellfish, which represents 63 percent of the total regional value.

The top 10 commercial fisheries, in order of decreasing dollar value are: shrimp, blue crab, fish (other), calico scallop, swordfish, hard clam, menhaden, flounder (fluke), gray seatrout, and king mackerel. When compared to the total U.S. species-specific landings data (ex-vessel value), this region accounts for 99 percent of all the calico scallops landed and 56 percent of the gray seatrout harvested.

Major fishing ports in the south Atlantic, listed in order of decreasing dockside value, are: Beaufort-Morehead City (NC), Wanchese-Stumpy Point (NC), and Oriental-Vandemere (NC).

Southern portions of the south Atlantic region produce the most valuable regional fishery -- shrimp. The general term "shrimp," as reported in NMFS statistics, can mean pink, brown, white, rock, and the deepwater royal red shrimp. These species are the mainstay of the Georgia and Florida (east coast) commercial fisheries. In the more northern portions of the south Atlantic region, other important fisheries include blue crab, calico scallop, hard clam, flounder (fluke), and gray seatrout. Throughout the south Atlantic region commercial fisheries are located primarily in nearshore and coastal waters. Of the top 10 species identified, only swordfish and king mackerel are caught offshore.

A developing fishery, not yet large enough to be included in the listing of top 10 regional fisheries, is the snapper-grouper fishery. This fishery is conducted over hard-bottom areas known to be dispersed randomly throughout the south Atlantic, generally in water depths less than 200 m. This same species assemblage is of considerable importance to saltwater recreational anglers, especially in waters off North and South Carolina.

### (4) Recreation and Tourism

The South Atlantic coast extends for over 1,100 miles from the North

Carolina-Virginia border to the keys of Florida. Sandy beach or barrier beach areas stretch for many miles providing ideal opportunities for water-oriented recreation and leisure activities. In addition to ocean-facing beaches, the natural features of the coastal area includes sea islands, inland water bodies and estuaries, creating a diversity of marine and terrestrial resources and plentiful opportunities for fishing and waterfowl hunting as well as nature studies such as bird watching.

The coastal lands of the South Atlantic are owned and managed by a variety of Federal, State and local government agencies and the private sector. The Federal government maintains well over two million acres of land which is heavily used for recreational purposes including National seashores, parks, wildlife refuges, and forests. States have set aside approximately 50 different State parks in the coastal areas in addition to aquatic preserves and local government parks. The biggest portion of shorefront land is held by the private sector and includes a variety of uses from undisturbed wooded areas and wetlands to intensively developed resort complexes. The latter include such tourist magnets as Myrtle Beach, Hilton Head, Seabrook and Kiawak in South Carolina and Jekyll Island and the Savannah/Tybee Island area of Georgia. The entire Atlantic coast of Florida is also strewn with resort areas and tourist attractions.

The natural features and recreational opportunities in the coastal south Atlantic create an ideal setting for a major tourist industry. Recreational visitation to National Park Service facilities exceeds six million annually and this represents only a small portion of overall travel and tourist activity in this area. Tourism is a major sector of the coastal economics of all the South Atlantic States, totaling an estimated 12 to 15 billion dollars worth of economic activity. The amenities of the coast attract the development of second-home communities - prominent components of many local economies which are usually not reflected in travel expenditures.

In North Carolina, Cape Lookout and Cape Hatteras National Seashores combine with several State parks on the coast and other attractions to accommodate over 3.7 million visitors annually (National Park Service and North Carolina Office of Parks and Recreation). Tourism ranks as the State's third largest industry. In coastal areas, however, this prominence is even greater as evidenced by the more than doubling of the populations of Carteret and Brunswick counties during the height of the summer recreational season. The estimated 1982 travel expenditures for those counties in the State's coastal zone total $484.7 million (Rulison, 1983). The second largest industry in the State of South Carolina, tourism and travel make a very significant contribution to the economy of the State's coastal region. Roughly three quarters of visitor expenditures in the State of South Carolina occur in the coastal area. These coastal expenditures exceed $1.5 billion (South Carolina Department of Parks, Recreation and Tourism). Travel and tourism in coastal Georgia rank as the single largest segment of the coastal economy attracting an estimated 3.5 million visitors annually and generating approximately $369.74 million in expenditures (derived from figures provided by Coastal Area Planning and Development Commission). Very popular as a tourist destination, the

Atlantic coast of Florida attracts over 21 million visitors annually including a substantial number of international visitors. Florida's Atlantic coast possesses a vast tourist trade as evidenced by annual expenditures in excess of $12 billion (derived from figures provided by the Florida Department of Commerce, Division of Tourism).

### (5) Archaeological Resources

The earliest undisputed date for man's occupancy of the North American continent east of the Appalachians is approximately 12,000 YBP. At that time the shoreline was located in proximity to the 40-m depth contour. Consequently, any area landward of this line has the greatest potential for containing prehistoric resources.

Within the zone shoreward of the 40-m depth contour, the Continental Shelf off South Carolina and Georgia appears to have the greatest potential for containing preserved prehistoric resources. This portion of the shelf was traversed by rivers which provided a source of fresh water for prehistoric man and his prey in addition to transporting required crystalline rock materials for toolmaking. Deposition of a thick sedimentary sequency in this area assures a high probability of preservation. Areas with the least likelihood of containing submerged archeological resources are located off the North Carolina and Florida coasts. Here it is quite possible that erosive forces cut below the level at which archeological artifacts were buried.

Within the South Atlantic region, shipwrecks tend to be concentrated at the extremes of the region. This is logical when one considers that the Cape Hatteras and southern Florida areas are the two major areas of hurricane occurrence along the southern U.S. Atlantic coast. Indeed, the area off Cape Hatteras has been referred to as the "Graveyard of the Atlantic," containing about 130 documented wrecks. The areas off Capes Lookout and Fear also contain significant shipwreck clusters, although not as many as off Cape Hatteras.

### (6) Marine Vessel Traffic

The major ports of the south Atlantic region are Jacksonville and Port Everglades, Florida; Savannah, Georgia; Charleston, South Carolina; and Wilmington, North Carolina, handling between 9 and 16 million short tons of cargo per year. Lesser ports, in terms of tonnage handled, include Miami and Cape Canaveral, Florida; Brunswick, Georgia; and Morehead City, North Carolina. Of these ports, only Port Everglades and Savannah handle in excess of 400,000 short tons of crude petroleum per year.

In this region, vessels involved in moving cargo do not follow a formalized vessel routing system. From preliminary findings, the Coast Guard, which undertook a study of the entire U.S. coast to determine the need for the regulation of vessel traffic, concluded that, at present, new vessel routing measures (Traffic Separation Schemes--TSSs) were unnecessary (FR, October 1, 1981).

### (7) Military Uses

The John F. Kennedy Space Center (KSC) at Cape Canaveral Florida is a NASA installation from which numerous space satellites as well as the space shuttle are launched. The military uses the Eastern Space and Missile Center (ESMC), also located at Cape Canaveral, to test various types of missiles. The area offshore is also used for submarine launch activities. The flight clearance zone for the KSC and the ESMC is the extent of the area which NASA and DOD require to be kept free of surface activity during missile and shuttle launches (Figure III.A.3.a.6-1).

## 4. Straits of Florida

### a. Physical Environment

#### (1) Geology

The continental shelf and slope is a continuation of the Florida platform, which is composed of Mesozoic-Cenozoic carbonates. The Straits of Florida Planning Area (SFPA) shelf area has been removed since Mesozoic times from the major locus of rapid sedimentation. In particular, Pleistocene sediments which attain great thicknesses over the continental shelf of the rest of the northern Gulf of Mexico are virtually non-existent in the Florida Straits shelf. The fine grained sediments that manage to filter through the South Florida Keys are flushed out of the SFPA by the Gulf Stream. The higher features of the shelf are Pleistocene coral and oolite reefs. The higher of these reefs are emergent as the Florida Keys and extend from the Marquesas to Key Biscayne. Very little data exist for the Straits of Florida, so it is difficult to predict the hydrocarbon potential. Production has been established in southern Florida and northern Cuba, and noncommercial shows have been found in the Florida Keys and the Bahamas, all of which are a part of the South Florida Basin that underlies the Straits of Florida. It can, therefore, be assumed that a reasonable potential for hydrocarbons exists.

#### (2) Geologic Hazards

The Straits of Florida Planning Area has a complex geologic structure with a resultant geomorphologic environment that includes several seafloor processes: slumping, growth faulting, down-to-the-basin tectonic faulting, solution forming karst, and possibly submarine currents. The Portales Terrace has very rugged and complex topography that is the result of carbonate solution and the formation of sinkholes. Faulting in the straits has produced a very steep slope and several escarpments tens of meters high. Whether the faulting, shallow and deep, is active at present, is not known. In some areas, the slumping along the oversteepened Florida escarpment may be post-Pleistocene.

#### (3) Non-Petroleum Mineral Resources

Phosphate and manganese nodules have been recovered from the edge of the Pourtales Terrace in approximately 300 meters of water. The age has been estimated at post-middle Miocene. The nodules are probably erosional or solution remnants from the Hawthorne Formation present as an outcrop on the Pourtales Escarpment.

#### (4) Oceanography

##### (a) Chemical

Phosphate concentrations in the SFPA are generally less than 0.2 uM (0.0000002 Molar), and surface concentrations are usually less than 0.05 uM. In nearshore areas phosphate concentrations are higher. In the offshore area,subsurface intrusions of Gulf Stream water supply large amounts of phosphate to the shelf waters. Phosphate may reach 1.0-1.5 uM at 50 m.

Nitrate concentrations are very low in the shelf surface waters with values less than 0.1 uM typical. Subsurface intrusions of deeper Gulf Stream water supply large amounts of nitrate to the shelf waters. Concentrations typically reach 10-20 uM at 50 m. This process supplies 20%-50% of the nitrate required for phytoplankton growth.

Nearshore concentrations of silicate range from 1-20 uM, and offshore surface concentrations are usually less than 2 uM. Silicate is advected onto the shelf by intrusions. Because of this process silicate often is above 10 uM in the subsurface waters.

The surface concentration of dissolved oxygen over the southeast Florida coast, shelf, and slope during fall ranges from 4.17 to 5.01 ml/1. The concentration remains the same during winter except near shore where values increase to greater than 5 ml/1. During the rest of the year distributions remain about the same except for changes in pockets of low concentration nearshore. The oxygen minimum at mid-depths is a result of the intrusion of subsurface Caribbean water during some time periods.

Southern Florida shelf waters are fairly saline compared to coastal water further north. This high salinity results from low freshwater runoff and close proximity to the Gulf Stream. Isohalines tend to parallel the coast with largest gradients nearshore. Shelf salinity varies seasonally with lower salinities in late winter and spring and higher values during summer and fall. The high salinity durinq summer and fall can be attributed to low runoff during that period and to prevailing southeast winds. Another factor that may result in higher salinities over the shelf is intrusion of Gulf Stream water. Surface salinities and bottom salinities may show a large variance at certain times. This vertical salinity variance depends largely upon meanders of the Gulf Stream, mixing, and wind velocity (direction and speed). Surface salinities in the Gulf Stream are occasionally measurably lower than normal due to entrainment of Mississippi River water. Northward extensions of the Loop Current entrain Mississippi River water, and it is then transported to the Gulf Stream, through the Straits of Florida, and then along the southeast coast. The concentration of trace metals shows a decrease from north to south where levels approximate those of the Gulf Stream. The south to north increase in the trace metal gradient results from shelf flushing provided by the Gulf Stream. In the southern portion of the area, Gulf Stream currents are closer to shore resulting in constant movement northward of trace metal. Farther north, the Gulf Stream moves away from the coast resulting in the deposition of trace metals in sediments with no flushing. The trace metals are mostly derived from land drainage and industrial wastes and deposited accordingly.

### (b) Physical

The Straits of Florida planning area consists of a very shallow shelf area that is very large (spatially) north and west of the Keys and Dry Tortugas, and very narrow to the south and east. The continental slope south and east of the Keys is fairly steep. Circulation in this region is very similar to that described for the Eastern Gulf of Mexico Planning Area, especially that part of the planning area north of the Keys that is directly adjacent to, and actually a southern extension of the broad Eastern Gulf continental shelf. Circulation in this portion of the Straits of Florida is predominantly wind- and tide-driven. Historic observations of surface currents in this region indicate that the predominant direction is to the North (NNE to NNW) with velocities ranging from 0.5-1.0 knots.

Dominant circulation south and east of the Keys is a strong flow from west to east, curving north to roughly parallel the Florida coastline. This joins with a weaker current that flows along the northeast coast of Cuba and continues north toward Cape Hatteras and beyond. Often referred to as the Florida Current, this is the transition between the Gulf of Mexico Loop Current and the Atlantic Gulf Stream. Because of the narrow shelf, this persistent flow of warm Gulf water is in very close proximity to land.

### (5) Water Quality

The alteration of natural drainage patterns by canals within southern Florida has had a major effect on the water quality of its surrounding coastal estuaries and bays. As a result of spring runoff and flood conditions in the State's interior, these artificial waterways serve to channel freshwater rapidly into the coastal waters of the region, along with accumulations of pesticides, oil and grease, coliform bacteria, and other substances. The estuarine waters of the Intracoastal Waterway and the smaller estuarine areas between the Indian River and Biscayne Bay are similar to those of the larger systems; however, the impacts of polluted canal discharges are more severe here as a result of poor circulation and exchange with the Atlantic. The southern portion of this waterway has almost been completely lined with bulkheaded residential developments, and water quality in these areas is expected to further decline as soft anaerobic sediments and other pollutants accumulate. These sediments reach several feet in thickness, frequent dredging is required, and disposal of this noxious dredge spoil poses a problem (SFRPC, 1976 and 1978).

The general water quality in the northern Biscayne Bay area is poor, largely due to surrounding urban development and the quality of water flowing into the Bay from canals and rivers. As stated previously, these canals receive many wastes, domestic as well as industrial, along with surface runoff from urban and agricultural areas and seepage from malfunctioning septic tanks. Studies of these canals show that water quality within the canals is so poor that even slight increases in contaminants will exceed general water quality standards. In some areas these canals are known to penetrate to the top surface of the existing shallow aquifers so that canal and ground waters interchange, and although many of the larger contaminants are filtered out as the water moves through the aquifer, viruses and toxins may remain in solution and cause human health problems. Florida Bay, which is the largest bay in the South Florida region, comprises one of Florida's richest marine resource areas. A primary threat to this area has resulted from development within the Keys and associated dredging activities which have already interferred with the natural functions of the environment. One effect of this dredging has been the destruction of the mangrove gringe which slows and filters surface runoff to the sea. Dredging has further removed numerous tidal marshes that convert surface runoff contaminants to food and provide shelter for aquatic organisms, and has created a special siltation problem. In contrast to natural storm-caused turbidity and siltation, dredge silt includes very small, sterile marl particles that can stay in suspension for as long as 3-5 years. Upon settling, the larger sterile particles form a suffocating layer that prevents marine organisms from developing. Another cause of increased turbidity, as well as excess nutrification of the Bay shallows, results from septic tank effluent seepage. This seepage results in increased turbidity and causes plankton blooms, while introducing sewage toxins that can damage or kill more sensitive marine organisms (SFRPC, 1973 and 1976).

The Florida Everglades area consists of approximately 4,000 sq. miles of freshwater marsh extending from Lake Okeechobee south to Florida Bay. Water in the Everglades basin typically has a high content of organic material as compared to other natural drainage basins, as indicated by measurements of total phosphorus, organic nitrogen, and total organic carbon (TOC). One of the more serious threats to the Everglades ecosystem involves the biomagnification of chlorinated hydrocarbon pesticides and PCB's which enter this system. In South Florida, insecticides and fungicides, as well as herbicides, are used extensively for agriculture and horticulture and for the control of vegetation along roads and in canals. Chlorinated hydrocarbons found in bottom materials sampled within the Everglades have the potential of entering the food chain through organisms in the detrital trophic level, which in turn are ingested by the consumers (USGS, 1982).

### (6) Ocean Dumping

There are no EPA approved industrial ocean dumping sites in the Straits of Florida area. There are, however, two dredged material disposed sites within the potentially leasable (not deferred) portion of the planning area (Figure III.A.4.a.6-1). Also, there is one major site formerly used for dumping of undetonated explosives.

### (7) Climate

The Straits of Florida are within a tropical climatic regime. Warm, moist, easterly trade winds influence the area throughout the year. Temperatures average near 22°C (72°F) during the winter and spring months and near 28°C (83°F) during the summer and fall months. Rainfall averages 102 cm per year at Key West and varies little area wide. Dense fog only occurs about one day per year. This area could be affected by tropical storms or hurricanes slightly more than the remainder of the Gulf because of a preferred path between Cuba and Florida over the warm waters of the Straits.

### (8) Air Quality

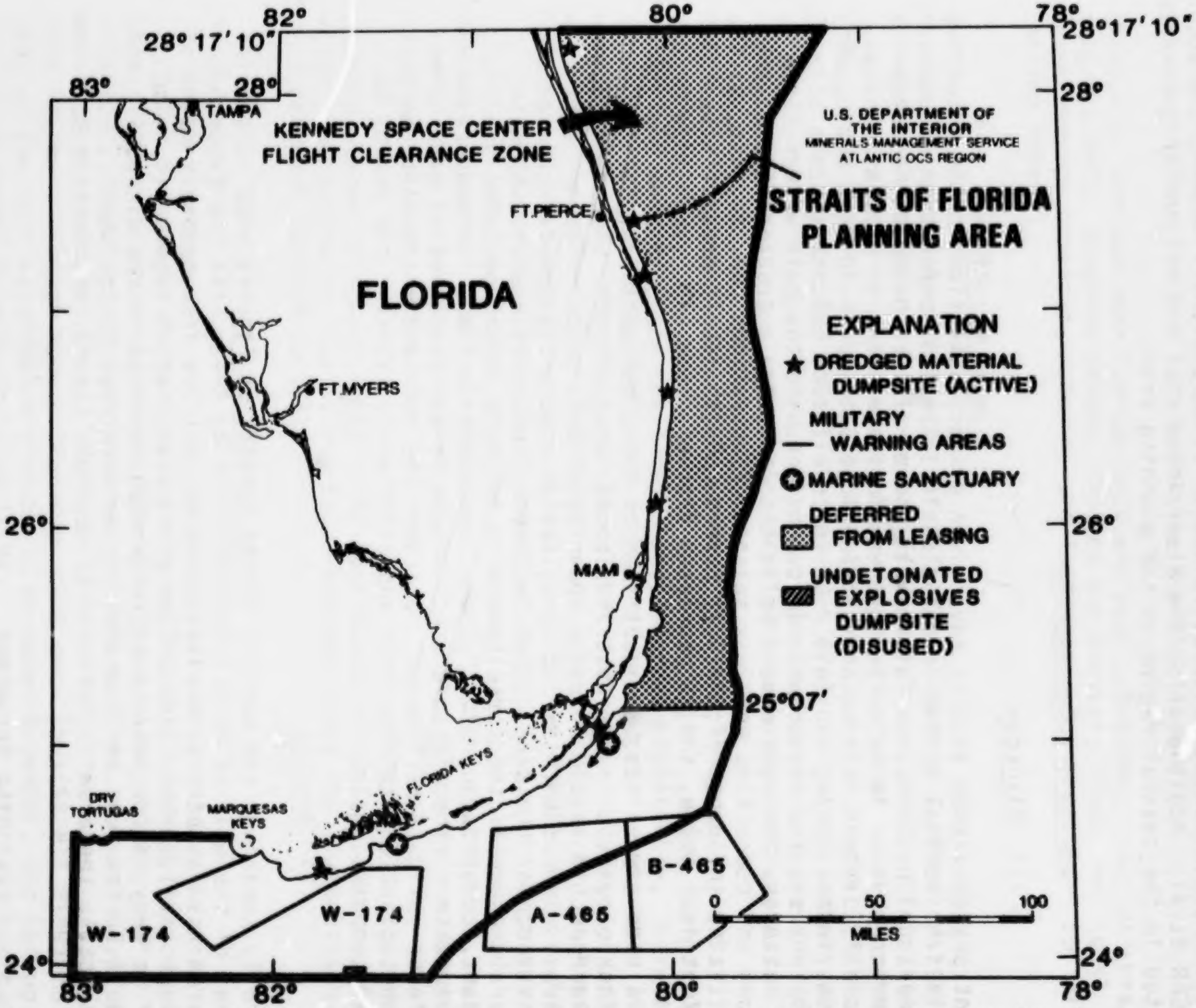


Figure III.A.4.a.6-1. Dumpsites, Military Areas, and Marine Sanctuaries in the Straits of Florida Planning Area.

The SFPA which consists of the southeast tip of Florida contains both nonattainment and Prevention of Significant Deterioration (PSD) Class 1 areas. Broward and Dade Counties are classified as nonattainment for Ox (40 CFR 81.3). There is one PSD Class 1 area known as the Everglades National Park, located adjacent to and in close proximity to offshore areas (40 CFR 81.4). Additionally, the Miami industrial and metropolitan area is located in the coastal region of the planning area.

### b. Biological Environment

#### (1) Plankton

Recent phytoplankton studies have given primary attention to the estuaries and less to coastal streams and the shelf. Species composition, abundance, and seasonal patterns are fairly well-known. In freshwaters the dominants are chlorophytes, in estuaries either dinoflagellates or diatoms, and on the shelf, diatoms. In estuaries dinoflagellates peak in late summer and diatoms in the spring and fall. On the shelf over 600 species of phytoplankters are now known. In comparison with the cold waters above Cape Hatteras, the warm waters below the Cape show a greater diversity of diatoms and coccoliths and less seasonal fluctuations due, in part, to the stabilizing influence of the Gulf Stream. On the shelf productivity is greatest near shore, and it decreases farther out.

Little recent work has been published on the distribution of shelf zooplankton except on the distribution of larval fishes. The distribution of pleuronectid larvae suggests spawning of this group north of Cape Hatteras, whereas bothids and cynoglossids apparently spawn in the warmer waters south of the Cape. Spawning seems highly correlated with water temperature and little correlated with salinity. Siphonophones are abundant, constituting 17.7% of the zooplankton volume. In comparison with neritic waters, the offshore areas have a larger component of carnivores and fewer obligate herbivores. Offshore the zooplankters utilize most of the phytoplankton standing crop and efficiently transfer the energy to higher trophic levels.

#### (2) Benthos

Generally speaking, the benthos of the Straits of Florida area is similar to that of the Gulf of Mexico Eastern Planning Area; like the Eastern Gulf, the area has not been extensively studied, but the area probably has numerous small, patchy line bottom areas scattered throughout it. The shelf is very narrow here (especially when compared to the wide CPA), and the Gulf Stream runs northward on the eastern edge of the shelf. Biologically the area is expected to resemble closely the Eastern Gulf (see Section III.B.3.b.(2)).

#### (3) Fish Resources

Species of commercial and recreational importance in the SFPA include groupers, snappers, grunts, jacks, marlins, sailfish, mackerels, drums, bluefish, mullets, pink shrimp, stone crabs, and spiny lobsters. Estuarine dependent species include pink shrimp, stone crab, spotted and sand seatrout, red drum, tarpon, snook, white and striped mullet, and sheepshead. Reefs provide important habitats for species such as spiny lobster, snappers, and groupers. Oceanic species include jacks, Spanish and king mackerel, sailfish, and white and blue marlin.

Throughout the southern Florida area are vast estuaries, tidal marshes, seagrass beds, mangrove swamps, shallow mud and sand flats, and coral reefs which provide breeding, nursery, and feeding grounds for almost all of the species noted.

### (4) Marine Mammals

The Marine Mammal Protection Act of 1972 established a national policy designed to protect and conserve marine mammals and their habitats. About 31 species of marine mammals have been reported to occur in or migrate through the potentially leasable (not deferred) portion of the Straits of Florida area (Schmidly, 1981). Those which occur in coastal waters are primarily three groups: the West Indian manatee; small cetaceans (porpoises and dolphins); and occasionally large cetaceans (whales).

Bottlenose dolphins are fairly common in the SFPA; they occur in bays, inland waterways, ship channels, and nearshore waters. Fish, primarily mullet and menhaden, are their major food source. Apparently, there are two groups of bottlenose dolphins - small discrete populations that inhabit coastal areas and offshore populations that congregate in large groups. An estimated population density of bottlenose dolphins offshore Fort Pierce, Florida, indicates about 1 dolphin/mi2 (1 dolphin/2.6 km2) (Fritts et al., 1983). Dolphins usually occur in herds of 3-7 animals, but large herds of 200-600 dolphins have been observed. Spotted, striped, and spinner dolphins are other small cetaceans which occur in the continental shelf waters. Short-finned pilot and pygmy sperm whales occur in the deeper slope and oceanic waters.

Usually, large cetaceans inhabit the continental slope and deep oceanic waters; occasionally, whales are found beached along the southeastern Florida coast (Schmidly, 1981).

### (5) Coastal and Marine Birds

The beaches and coastal wetlands of the Straits of Florida area are inhabited by several migrant and nonmigrant coastal bird species consisting primarily of three general groups: shorebirds, wading birds, and waterfowl. Feeding and nesting areas include beaches, coastal bays, and other coastal wetland areas. Reproductive activity for these groups occurs from February through August (Portnoy, 1977 and Clapp et al., 1982). The peak of the fall waterfowl migration is November-December, and spring migration occurs from March to early May. The major waterfowl habitats are coastal bays and wetland areas. The national wildlife refuges and State wildlife management areas provide important feeding, nesting, and resting areas for many of these migratory waterfowl.

About 25 species of marine birds, such as gulls, terns, boobies, petrels, and shearwaters, occur in the SFPA (Murphy, 1967 and Clapp et al., 1982). A sooty tern colony of about 30,000-50,000 breeding pairs occupies Bush Key in the Dry Tortugas, about 71 miles (115 km) west of Key West, Florida, from April-August. Marine birds primarily feed and roost offshore, coming ashore for nesting or when storms blow them inshore. Generally, the largest concentrations of marine birds are found near upwelling areas (near the continental slope edge) and other areas of high productivity. Because of their marine habits, population and distribution data for marine birds are limited.

### (6) Endangered and Threatened Species

Five federally listed endangered whale species occur in the SFPA. These include the finback, humpback, right, sei, and sperm whales. Generally, these large cetaceans inhabit the continental slope and deep oceanic waters (Schmidly, 1981). During the winter months manatees concentrate along the coast of peninsular Florida from the Crystal River (west coast) to Titusville (east coast). During the summer months the population, estimated to be about 800-900, disperses along the coast (Irvine et al., 1981). Manatees are usually found in coastal waterways and prefer water depths of 1-3 m; migration to deeper waters offshore has not been documented.

The Key deer range is restricted to a few islands in the lower Florida Keys, chiefly Big Pine and No Name Keys. Current population is estimated to range from 400-600 animals. The endangered Key Largo woodrat and cotton mouse are distinct subspecies native to Key Largo in Monroe County, Florida. Also, the endangered Schaus swallowtail butterfly occurs in the Key Largo area.

Four federally listed endangered turtle species (green, hawksbill, Kemp's ridley, and leatherback turtles) and one threatened species (loggerhead turtle) occur in the SFPA. The green turtle is listed as endangered in Florida waters and threatened throughout the rest of the Gulf. The green turtle is found throughout the Gulf where its favored habitats are lagoons and shoals providing an abundance of marine grass and algae on which it feeds. Green turtle nesting has been reported along the southeastern Florida coast, and juvenile green turtles occur frequently along the southwest Florida coast. The hawksbill turtle inhabits reefs, shallow coastal areas, and passes in water less than 20 m deep. Recently, two hawksbill nestings have been reported for the west central Florida coast. The Kemp's ridley turtle inhabits shallow coastal and estuarine waters. No ridley turtle nesting has been reported for the SFPA. The leatherback turtle is the most pelagic sea turtle and may be found near the continental shelf edge. No recent leatherback nesting has been reported in the SFPA. The loggerhead turtle nests on various barrier islands and beaches from the Florida Keys, up the southeast Florida coast where the majority of nesting in Florida occurs.

The American alligator occurs generally throughout the SFPA in fresh to brackish water areas. The alligator occurs throughout the coastal areas of

Florida where it is listed as "threatened by similarity of appearance." American crocodiles are restricted to southern Florida, chiefly along Florida Bay and on adjacent Key Largo. Current population is estimated to range from 200-400 animals.

Arctic peregrine falcons migrate along the eastern coast of Florida and the Florida Keys. Some peregrine falcons overwinter along the Florida coast. Bald eagles inhabit the Straits of Florida coastal area.

A federally listed endangered plant species, keytree cactus, occurs within the boundaries of the Key Deer National Wildlife Refugee, chiefly on Big Pine and No Name Keys.

### (7) Estuaries and Wetlands

The following habitat types are characteristic of the SFPA: estuarine open water and bottoms, coral reefs, seagrass beds, islands, mangroves, forested wetlands, non-forested wetlands, and terrestrial habitats. Non-forested and forested wetlands form an interface between the marine and terrestrial habitats, while estuarine open water occupies the area between the wetlands and the open Gulf. These coastal habitats are highly productive for a great number and wide variety of invertebrates, fish, herpetofauna, birds, and mammals. The central origin of the biologic productivity in the SFPA is the vegetated estuarine habitats, primarily the mangroves, marshes, seagrass beds, coral reefs, and forested wetlands.

### (8) Areas of Special Concern

Live bottom areas are of concern because of their biological productivity as well as their use as fish habitats (Section III.B.4.b(3)). Live bottom areas have, in the past, enjoyed the protection of a biological stipulation on leases in the vicinity designed to protect these areas from potential damage due to oil and gas exploration and development activities. In general, the stipulation has required the lessee to prepare a map showing potential live bottom areas and to document with photographs the presence or absence of live bottoms. If such areas are present, the lessee must take steps to protect them. Studies indicate that these stipulations have worked well. In addition, the Oculina Coral Bank has been designated a Habitat Area of Particular Concern (HAPC) in the South Atlantic Fishery Management Council's Coral Management Plan, which became effective on August 22, 1984. Within the HAPC certain restrictions on fishing gear are imposed. For a complete description of the stipulations and their rationale, see Section II.A.1.c.(1) of the FEIS for proposed Sales 94, 98, and 102 (USDI-MMS, 1984).

The Florida Reef Tract of the Keys is the most extensive example of typical tropical coral reefs in the United States. Furthermore, two National Marine Sanctuaries have been established in the Keys at Looe Key and Key Largo (Section III.B.4.b.(9)). Although the Keys have been highly developed by housing and industry, these offshore reefs remain areas of great biological productivity and beauty. For a detailed description of the Keys, see Section III.D.2. of the FEIS for proposed Sales 94, 98, and 102 (USDI-MMS, 1984).

### (9) Marine Sanctuaries

There are two marine sanctuaries established in the SFPA. The Looe Key National Marine Sanctuary is one of several sites established by the National Oceanic and Atmospheric Administration to protect and manage special marine areas throughout the coastal waters of the United States. The Sanctuary consists of a submerged section of the Florida reef tract located 6.7 nautical miles southwest of Big Pine Key in the lower Florida Keys. It encompasses 5.3 square nautical miles of Federal waters surrounding a well-developed coral reef. The area is a popular spot for many recreational activities such as scuba diving, snorkeling, fishing, and boating. The spectacular coral formations and the diverse marine community they support are major attractions that account for the popularity of the Sanctuary. Protective measures are taken to guarantee the integrity of the Sanctuary while allowing maximum compatible use of the area. Several different types of reefs and associated habitats, such as seagrass beds, patch reefs, and sand flats, are found at Looe Key. The most spectacular of these areas is the fore reef zone, which is a high-profile "spur and groove" coral system centrally located within the Sanctuary. It extends from a shallow water reef crest down to a sand bottom 9-11 m deep. Thousands of brightly colored fish can be seen swimming among branching elkhorn and staghorn corals. The massive pillar coral structures and huge brain corals contrast with the delicate soft coral sea fans and sea whips. Lobsters and crabs occupy the crevices and other openings in the reef. In addition to the biological resources at Looe Key, several shipwrecks are found within the Sanctuary. The remains of the H.M.S. Looe, a British frigate that sunk in 1744, consists of cast iron ballast blocks and scattered remnants of the ship's structure that lie partially buried in the sand.

Key Largo National Marine Sanctuary is located in the upper Keys adjacent to but seaward of Florida's John Pennekamp Coral Reef State Park. The full reef complex or ecosystem includes a large array of West Indian corals, algae, sponges, shrimp, crabs, lobsters, mollusks, and a host of tropical fish species. The major ecological zones are: (1) rubble, (2) millipora, (3) acropora, (4) open sand, (5) grass beds (primarily thalassia), (6) alcyonarian, (7) reef flat, and (8) back reef. Residents and tourists attracted to the area by the beauty of the reef system participate in the recreational endeavors of boating, sailing, snorkeling, swimming, diving, and sport fishing. Commercial enterprises that supply services for these forms of recreation operate adjacent to the area and within the proposed boundaries. Other commercial enterprises also utilize the area. Lobster pot fishing occurs. Commercial transportation occurs where water depths permit.

## c. Socioeconomic Environment

### (1) Employment and Demographic Conditions

The Straits of Florida include the southwestern Florida Gulf of Mexico. Data collection was limited to Collier, Dade, and Monroe Counties because these are the areas most likely to be affected by offshore leasing in the SFPA.

Employment in the region averaged 826,900 in 1983, with the labor force averaging 917,700 in the same year. The highest levels of employment are found in the sectors of services, trade, and manufacturing, in order of magnitude based on 1981 Department of Commerce data. Overall, population growth over the 1978-1981 period was 17.5% while over the same period, total personal income and per capita personal income increased by 52% and 29%, respectively.

### (2) Coastal Land Use and Water Services

The SFPA includes the Florida Keys and Florida Bay. The mainland coast of the SFPA is composed of mangrove and marsh areas with little or no urban development. The Keys, however, are relatively well developed with tourist-oriented commercial and residential land use. Preservation areas exist on both sides of the Straits including Everglades National Park and numerous State recreation areas.

The water resources of South Florida are limited in quantity as a result of annual rainfall and above- and below-ground storage capacity of this area. Although east coast underground water supplies are augmented by water from Lake Okeechobee, rainfall is the essential method of aquifer recharge here. Nearly all of the municipal water supplies of the region come from underground sources, which consist of four known and relatively shallow aquifers. The Florida Keys and other offshore land areas, however, yield only small amounts of fresh groundwater from the isolated pockets of freshwater that collect rainfall, captured in the soil, and form a bubble on the surface of underlying saltwater. Such a lens will tolerate only limited amounts of pumping and must be recharged frequently. Since the Keys have no significant supply of fresh groundwater, it must be pumped from the Biscayne aquifer and delivered by pipeline to the Keys. Water use in the Keys has begun to reach or exceed the capacity of this pipeline in spite of the water supplied by the desalination facility at Key West. Nature, urban, and agricultural needs now compete for a relatively finite quantity of water in South Florida. Wetland and estuarine ecosystems depend on a seasonally varied flow of water that is relatively constant on an annual basis. On the other hand, current urban needs within this region are not constant and are increasing in proportion to population growth and increased per capita use (SFRPC, 1973 and 1976).

### (3) Commercial Fisheries

The most important commercial species in the SFPA, in terms of both yield and value, is the pink shrimp. This species is fished throughout the year in water depths averaging from 10 to 36 meters. The spiny lobster represents the second most valuable fishery with a commercial season which extends from July 26 to March 31. The king and Spanish mackerels represent the first and second most important commercial finfish fisheries, respectively, and perhaps the most popular offshore sport fish species Gulfwide. The mackerels are fished through the year but are most abundant during the winter months in south Florida because of the migratory patterns (Beccasio et al., 1982).

### (4) Recreation and Tourism

The coastal and nearshore environment of southern Collier and Monroe Counties is atypical and unique from a recreational standpoint. The coastal area from the Ten Thousand Islands throughout the Big Cypress and Everglades areas to the Florida Keys and Dry Tortugas is a very special, highly utilized shorefront/nearshore recreational environment not necessarily focused around major recreational beaches and not totally included within designated environmental preservation areas. Furthermore, although sports fishing is a widespread, major recreational activity, some of the major target species such as snook and bonefish occur nowhere else in the Gulf region. Characterized by clear water, mangroves, coral, and tropical fauna and flora, the expansive Florida area south of Cape Romano is an intensively utilized recreational and tourist environment sustained by the quality and uniqueness of its natural resources.

### (5) Archaeological Resources

Based on information provided by the cultural resources baseline studies for the northern Gulf of Mexico (CEI, 1977) and the South Atlantic (SAI, 1981), MMS records show approximately 63 confirmed shipwrecks in the SFPA. Another 319 ships from all historic periods are documented sinking in the SFPA; however, the locations given for these reported wrecks are not sufficient to allow mapping. Relict barrier islands with back-barrier bays and lagoons, karst topography, and coastal dune lakes are all features which may occur within the SFPA and which have a high potential for the occurrence of associated prehistoric sites. Preservation of site materials would be very good in karst areas and in back barrier bays and lagoons where sites were buried in a low-energy environment prior to the marine transgression of the area. Recovery of site information would be facilitated by the generally thin sequence of Holocene sediments across the SFPA.

### (6) Marine Vessel Traffic

Marine vessel traffic visiting ports in the SFPA made up about 4% of the total GOM Region traffic in 1981. However, this figure does not include the extensive amount of traffic that traveled through the Straits of Florida on its way to and from other GOM ports and the Atlantic Ocean. Most of the traffic heading into the Gulf travels a route that runs southward parallel to the east Florida coast and heads westward south of the Keys to a point south of the Dry Tortugas where it diverges on headings to the various GOM ports. Traffic leaving the Gulf follows the same basic route but stays farther offshore, using the Gulf Stream to facilitate passage. The major ports in the area are Key West and Miami. These ports are linked by the Atlantic Intracoastal Waterway which is generally traveled by vessels with shallower drafts.

### (7) Military Uses

More than 60% percent of the potentially leasable (not deferred) portion of the planning area is used by the Air Force and Navy for air, surface and subsurface operations (Figure III.A.4.a.6-1). Warning Areas 174 and 465 are operated in by the Navy for carrier maneuvers, carrier pilot training, gunnery and bombing practice, and submarine maneuvers. The Navy, also, has a surface and a subsurface submarine operating area out of Port Everglades, Florida. Warning area 174 is used intensively and extensively by the Navy, in particular during the winter months. The extent to which W-465 and the Port Everglades submarine operating area is used is unknown.

## B. Gulf of Mexico

### 1. Western Gulf of Mexico

#### a. Physical Environment

#### (1) Geology

The Texas and Louisiana shelf and slope are characterized by rapid rates of sedimentation into massive accumulations of silts, clays, and numerous sand deposits in buried channels and small basins between uplifted domes. The area is absent of any major regional structures. However, thousands of small diapiric structures are present to influence the stratigraphy, sediment basin locations, and channel deposits.

The prospective horizons of the northwestern continental shelf are of Miocene, Pliocene, or Pleistocene age. The environment of deposition of the continental shelf and slope in the northern Gulf of Mexico is one of the most significant factors controlling hydrocarbon production. Sediments deposited on the outer shelf and upper slope have the greatest potential for bearing hydrocarbons due to the following reasons: (a) This is the location where nearshore sands interfinger with the deeper-water marine shales providing an optimum ratio of sandstone to shale. The shale may be the source rock that provides the oil and gas while sandstone provides the reservoir into which the hydrocarbons migrate and are trapped; (b) In this environment, the organic material deposited with the fine-grained clays and muds is preserved, and not oxidized as it might be in shallower, more turbulent water; and (c) It is at this location that the increased overburden of the prograding shallow marine deposits move the plastic salt and marine shales which initiates the salt flow that triggers the growth of salt domes and regional expansion faults which in turn provide traps for the hydrocarbons. This environment, therefore, is the optimum zone for encountering the three ingredients necessary for the successful formation and accumulation of oil and gas: reservoir rock, source beds, and traps.

Offshore Louisiana sediments of Miocene and Pliocene age are overlain by a thicker section of Pleistocene sediments derived from the Mississippi River system. The Texas shelf, during Pleistocene time, received smaller volumes of sediment because it was on the western border of the Mississippi River depocenter.

Since production of oil and gas frequently occurs along the continental shelf-slope break, the progradation of the north-central Gulf depositional regime has resulted in the migration of this production zone seaward and in the development of a series of progressively younger producing trends.

Future production from the Pleistocene formations of the upper continental slope region (200-1,000 m water depth) adjacent to the Texas-Louisiana OCS, though certainly not improbable, remains speculative despite recent discoveries in deeper waters. The continental slope includes all of the relatively steeply sloping sea bed from the shelf edge to the abyssal floor. The prospective horizon of the upper slope may consist of a thin section of

Miocene and Pliocene overlain by a thick section of Pleistocene age. The Pleistocene sediments are considered the most prospective reservoir beds. The structural grain and hummocky topography of the slope are controlled primarily by salt tectonics. Virtually the entire province is underlain by gigantic salt stocks and swells. Basinal areas between salt structures of the upper slope contain a thickness of as much as 3,500 m of sediment, most of which appear to be muddy, slump deposits with infrequent turbidite sand zones. It has been speculated that turbidite sands of reservoir quality could be present on the upper slope especially in deposits of Pleistocene age.

### (2) Geologic Hazards

Within the Gulf of Mexico, major geohazards to oil and gas development are associated with seafloor geologic features which result in seafloor instability. Primarily, the hazards are produced by: (a) increased gradient at the edge of the continental shelf where it merges with the continental slope; (b) regional high rates of deposition on the continental shelf that causes isostatic adjustments and deep seated gravity faulting; (c) local high rates of unconsolidated sediments deposited on the increased gradient of the continental shelf edge that has led to intensive slumping and mudslides; (d) diapiric movement of low density material through overlying sediment that has caused extensive deformation, the damming of sediments, gravity faulting, and slumping; and (e) high gas content in rapidly deposited sediments. These seafloor instabilities present limitations and necessitate adaptations in the siting, structural engineering, and routing of pipelines, exploratory drilling, and production platforms.

### (3) Non-Petroleum Mineral Resources

In the Western Planning Area (WPA) there are no known non-petroleum mineral resources presently of interest or of economic value.

### (4) Oceanography

#### (a) Chemical

Nutrient concentrations are generally representative of open Gulf surface waters, but continental run-off influences nearshore surface concentrations, especially in spring. Nutrients are reduced to extremely low values after spring and summer blooms, but are replenished in the fall. The water column over the inner shelf is very nearly isothermal during the fall, winter, and spring months, showing a slight stratification only in summer. Temperatures characteristic of the mixed layer over the inner Texas shelf range from approximately 11-13 degrees C in late winter to 28-29 degrees C in late summer. Salinities range from open Gulf surface values of about 36.4% to 20% or less during the spring run-off or during heavy rainfall. A bottom nepheloid layer is nearly always observed. Chlorophyll is highly correlated with salinity decreases in this area, indiciating the influence of riverine input. The local input from Texas rivers is the major source of freshwater nutrients and turbidity in the region. These effects decrease with distance from shore. Most chlorophyll is found at the bottom of the water column, from the shore out to mid-shelf.

Beyond the nearshore region of heavy influence by Texas rivers, the effects of the Mississippi River are felt. Although salinity variations are seen to respond to Mississippian input, nutrients do not correspond as closely, due perhaps to some depletion during transit. Over all, the nutrient values are somewhat lower than inshore values. The intrusion of nutrient-rich, oxygen-poor water from apparent depths of 200-300 m is indicated, in many cases, with effects seen all the way up to 70 m depth. An area of major upwelling has been indicated along the shelf break. Productivity on the outer shelf exhibits much less variability which can be ascribed to riverine input. Chlorophyll values in this area average less than inshore areas, as expected, but an inverse relation with salinity is not found. Periodic upwelling events are probably of primary importance in regulating offshore biological production in this area.

### (b) Physical

One of the major features influencing Gulf circulations is the presence of an anticyclone gyre (recently thought to be a permanent feature) existing in the Western Gulf. Data in this area of the Gulf have been insufficient to fully define the character of this feature; however, its presence seems to be indicative of a permanent feature. It is thought by investigators that the gyre is fed by the Loop Current eddies that drift into the region, and also by wind stress.

A major storm event such as a hurricane or tropical storm can have unpredicatable influence on local circulation at or near its path. The repsonse to these storms can be characterized as abrupt changes in current speed and direction and rapidly building seas.

Studies of the Texas and Louisiana shelf imply that the circulation on the Louisiana shelf is actually part of an extensive circulation system. The currents in this area have been found to be more persistent than local wind, implying outside influence. The well-known westerly, southwesterly flow along the Louisiana inner shelf progressing along the Texas shelf in a more southerly direction is thought to be the coastal portion of a closed cyclonic circulation pattern covering much of the Louisiana and Texas shelf. A long, narrow region of cool water represents the ridgelike center of the cyclonic feature. The outside edge of the cyclonic feature is thought to be evidenced by predominant easterly currents found at the shelf edge near the Flower Garden Banks. The eastern most side of the cyclonic feature is the biggest unknown. For additional information, see DOE, West Hackberry Strategic Petroleum Reserve Site Brine Disposal Monitoring, Year I, Report Volumes I and II (1983). For a more detailed description of physical oceanography, see Volume 1, Section III.A.3 of the Final Regional EIS (USDI, MMS, 1983).

### (4) Oceanography

### (a) Chemical

Nutrient concentrations are generally representative of open Gulf surface waters, but continental run-off influences nearshore surface concentrations, especially in spring. Nutrients are reduced to extremely low values after spring and summer blooms, but are replenished in the fall. The water column over the inner shelf is very nearly isothermal during the fall, winter, and spring months, showing a slight stratification only in summer. Temperatures characteristic of the mixed layer over the inner Texas shelf range from approximately 11-13 degrees C in late winter to 28-29 degrees C in late summer. Salinities range from open Gulf surface values of about 36.4% to 20% or less during the spring run-off or during heavy rainfall. A bottom nepheloid layer is nearly always observed. Chlorophyll is highly correlated with salinity decreases in this area, indiciating the influence of riverine input. The local input from Texas rivers is the major source of freshwater nutrients and turbidity in the region. These effects decrease with distance from shore. Most chlorophyll is found at the bottom of the water column, from the shore out to mid-shelf.

Beyond the nearshore region of heavy influence by Texas rivers, the effects of the Mississippi River are felt. Although salinity variations are seen to respond to Mississippian input, nutrients do not correspond as closely, due perhaps to some depletion during transit. Over all, the nutrient values are somewhat lower than inshore values. The intrusion of nutrient-rich, oxygen-poor water from apparent depths of 200-300 m is indicated, in many cases, with effects seen all the way up to 70 m depth. An area of major upwelling has been indicated along the shelf break. Productivity on the outer shelf exhibits much less variability which can be ascribed to riverine input. Chlorophyll values in this area average less than inshore areas, as expected, but an inverse relation with salinity is not found. Periodic upwelling events are probably of primary importance in regulating offshore biological production in this area.

### (b) Physical

One of the major features influencing Gulf circulations is the presence of an anticyclone gyre (recently thought to be a permanent feature) existing in the Western Gulf. Data in this area of the Gulf have been insufficient to fully define the character of this feature; however, its presence seems to be indicative of a permanent feature. It is thought by investigators that the gyre is fed by the Loop Current eddies that drift into the region, and also by wind stress.

A major storm event such as a hurricane or tropical storm can have unpredicatable influence on local circulation at or near its path. The repsonse to these storms can be characterized as abrupt changes in current speed and direction and rapidly building seas.

Studies of the Texas and Louisiana shelf imply that the circulation on the Louisiana shelf is actually part of an extensive circulation system. The currents in this area have been found to be more persistent than local wind, implying outside influence. The well-known westerly, southwesterly flow along the Louisiana inner shelf progressing along the Texas shelf in a more southerly direction is thought to be the coastal portion of a closed cyclonic circulation pattern covering much of the Louisiana and Texas shelf. A long, narrow region of cool water represents the ridgelike center of the cyclonic feature. The outside edge of the cyclonic feature is thought to be evidenced by predominant easterly currents found at the shelf edge near the Flower Garden Banks. The eastern most side of the cyclonic feature is the biggest unknown. For additional information, see DOE, West Hackberry Strategic Petroleum Reserve Site Brine Disposal Monitoring, Year I, Report Volumes I and II (1983). For a more detailed description of physical oceanography, see Volume 1, Section III.A.3 of the Final Regional EIS (USDI, MMS, 1983).

### (5) Water Quality

The Texas coastal area has been plagued with numerous water quality problems in the past. Degradation of water quality has occurred from many sources, including domestic and industrial effluents, dredging operations, agricultural runoff, shipping, offshore operations, etc. The majority of these water quality problems occur in the Houston-Galveston and Beaumont-Port Arthur areas where the majority of Texas' energy-related facilities are located. Utilization of the Houston ship channel and the Sabine-Neches River complex as effluent receiving systems has seriously affected the water quality of these systems and the surrounding areas. However, effort has been made in the last several years to clean up these systems with an upgrade of industrial and municipal waste treatment systems, hence lessening the water quality degradation experienced in the past. Although the area between Sabine Pass and Lavaca Bay has been beset by numerous water quality problems, the majority of Texas coastal river basins exhibit acceptable water quality (Texas Water Quality Board, 1976 and Texas Department of Water Resources, 1983).

### (6) Ocean Dumping

There are no EPA approved hazardous waste ocean dumping sites in the Western Gulf Mexico. There are, however, dredged material disposal sites adjacent to dredged channels. Some of these sites may extend to the OCS, and may receive considerable quantities of material.

There is one ocean dumping site designated for the incineration of organohalogen wastes in the Western Guilf of Mexico. This site is shown in Figure III.B.1.c.1. The USEPA regulates ocean incineration under the authority of the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA) (33 U.S.C. §1401 et seq).

In 1976, USEPA designated the Western Gulf ocean dumping site for the incin-eration of toxic wastes (41 FR 39319). This site was designated for a period of five years. Only one ship was permitted to burn at a time, except under extreme emergencies. In 1982, USEPA redesignated the ocean disposal site for continuing use (47 FR 17817)). Except for transferring the management of the site to USEPA headquarters, the conditions of the use of the site remained the same as the 1976 designation. The Gulf Ocean Incineration Site is described in 40 CFR § 228.12.b.1. See Figure

There has been limited burning in the Gulf. During 1974 and 1975, Shell conducted two research and two operational burns in the Gulf. This was the first United States use of ocean incineration for the disposal of organochlorine wastes. Between 1974 and 1982 USEPA issued permits for three series of burns in the Gulf of Mexico. USEPA has developed proposed ocean incineration regulations based on the experience of these burns (50 FR 8222). All future burns will require a USEPA permit. No permit applications will be reviewed until promulgation of the final ocean incineration regulations.

### (7) Climate

The area is influenced by a maritime subtropical climate controlled mainly by the clockwise wind circulation around a semipermanent area of high barometric pressure alternating between the Azores and Bermuda Islands. This circulation, around the western edge of the high pressure cell, aided by the trade winds, results in the predominance of moist easterly wind flow in this area. Another factor influencing the climate in the Western Gulf is the persistency of high barometric pressure over the North American Continent during the winter months, resulting in rare periods of relatively dry northerly wind flow (USDC, NOAA, 1972). Humidity, cloudiness, visibility, precipitation, and air temperatures over the Western Gulf are typical of a maritime climate and show little diurnal or seasonal variation. Average summer temperature is 29 degrees C (84 degrees F). Winter temperatures average 21 degrees C (70 degrees F). Rainfall averages range between 69 cm at Brownsville, Texas, to 102 cm at Galveston, Texas. Cloudiness and poor visibility are more pronounced in the winter season. Occasional dense sea fog lingers near the coast for several days. Tropical storms also effect this area, and a hurricane can be expected at least once each five years (USDC, NOAA, 1972).

### (8) Air Quality

Air Quality of the coastal area along the Gulf of Mexico is measured against the National Ambient Air Quality Standards (NAAQS) resulting from the Clean Air Act as amended. These standards are designed to preserve the air quality of an area at a threshold necessary to protect public health and welfare.

The ambient air quality in any area is determined by utilizing special monitoring schemes (40 CFR 50) and is measured relative to NAAQS primary and secondary standards. Primary standards are designed to protect public health, and secondary standards are designed to protect public welfare. If a county or section of a county does not meet the primary and/or secondary standards, they are classified as nonattainment. Areas designated as Prevention of Significant Deterioration areas are identified as mandatory Class I Federal Areas where visibility is an important value. These areas are national and international parks and wilderness areas.

Air quality in the coastal region of the Gulf is generally considered good and in many areas is better than the national standards. Of the 16 coastal counties bordering the Western Gulf of Mexico, 10 are clean air counties. One county exceeds primary standards for TSP and five counties exceed primary standards for OX. Of these five, two also exceed standards for TSP.

There are no PDS Class I areas in the Western Gulf. All nonattainment areas in the WPS are identified below:

Cameron, Texas
  Nonattainment - Primary - TSP
Nueces, Texas
  Nonattainment - Primary - TSP and Ox
Galveston, Texas
  Nonattainment - Primary - Ox
Jefferson, Texas
  Nonattainment - Primary - Ox
Brazoria, Texas
  Nonattainment - Primary - Ox
Harris, Texas
  Nonattainment - Primary - Ox, TSP

The State of Texas has a State Implementation Plan for air quality coupled with regulatory enforcement and monitoring programs in operation.

Ambient air quality is considered to be a function of the size, distribution, and activity of a population and, more importantly, the industrialization of an area. Emissions from all sources, such as external combustion, solid waste incineration, internal combustion, evaporation, chemical processing, etc., make up the ambient air quality at any given time according to the particular rate of dispersion. These factors preclude the ambient air quality from remaining the same at all times and, in fact, work in unison such that peak and low conditions are observed as a function of time; i.e., at certain periods the controlling factors may cause the ambient air quality to meet or exceed NAAQS and at other times it may be far below. Meteorological conditions play a very important role in the dispersion of emissions, and thus, on the ambient air quality. Generally, long range transport of emissions will cause worst-case onshore conditions when a plume is traveling in a stable layer (strong inversion) over water, the winds are persistent in reaching shore, and unstable daytime conditions occur over coastal areas. These conditions are rare in the coastal Gulf Regions due primarily to prevailing meteorological and physiological characteristics.

### b. Biological Environment

#### (1) Plankton

Generalization about water column biota are difficult because of the patchy nature of biotic distributions. For more detail see Section III.B.2. of the Final Regional EIS and Section III.B.2. of the Final EIS for Sales 94/98/102 (USDI, MMS, 1984).

Phytoplankton sampling in the Northern Gulf of Mexico has been sparse, intermittent, and mostly unquantitative. The studies which have been made pertain only to the presence of certain species in given areas. Thus, it is difficult to recognize seasonal fluctuations or geographic shifts in phytoplankton abundance or species succession. Total phytoplankton density in samples of the study area ranged from zero to 30,000 cells per liter. The number of cells from the inshore stations was substantially greater than those from the offshore sites. Offshore abundance levels of phytoplankton were greatest during June through August and lowest during the months of October through March, while the periods of lesser abundance were during May through September. The data from the offshore study area were collected during a period when the Mississippi River had been at flood stage twice within 13 months and when (in the winter of 1974) extensive dredging operations were being conducted at Southwest Pass. These two factors no doubt affected the nutrient concentrations and turbidity of the offshore stations and may have resulted in less than typical results. Primary productivity could be inhibited or greatly reduced by any increased turbidity, because only after the turbidity decreased would phytoplankton be able to respond to nutrient loads received from the river discharge. Phytoplankton are important as the primary producers of the marine environment. As such they are the starting point in the marine food web, providing food for zooplankton, which in turn provide food for larger marine carnivores. Man, as a harvestor of a variety of marine fish and shellfish, is one of several animals at the "top" of the food web. In addition, phytoplankton play a significant role in the world's oxygen-carbon dioxide budget and, in ways as yet incompletely understood, also serve to detoxify (biodegrade) many pollutants found in the Gulf. Unfortunately, it is impossible to generalize regarding the distribution of phytoplankton in the Gulf of Mexico. It is clear from the data that have been collected to date that concentrations of phytoplankton are distributed in patches of various sizes which move with prevailing winds and currents. Other factors, poorly understood, affect the size and distribution of the patches, including availability of nutrients and grazing pressure; therefore, predictions regarding specific locations of a patch or species at any given time simply cannot be made.

Zooplankton comprise a major link between producers (phytoplankton) and higher tropic levels in the Gulf. The most abundant groups are the copepods, and they and other planktonic crustacea seem capable of ingesting both phytoplankton and detritus particles, and thus are important in the marine food web as other animals prey on them (LOOP, 1975). Common copepod species found in neritic Gulf waters include calanoid copecods and cyclopoid copepods. *Acartia tonsa* is a dominant nearshore form in bays and estuaries and is found less commonly offshore. Euphausiid crustaceans are also prominent members of the zooplankton assemblage. Possibly the most signficant carnivores in the zooplankton are the chaetognaths (arrow worms). Copepods dominate their diet but this may be an artifact based on relatively high copepod abundance. They also feed on fish and barnacle larvae. The genus *Sagitta* is common worldwide and is typical in the Gulf. Other common carnivores in the zooplankton include the ctenophores, medusae of various species, ostracods, cladocerans, mysid and amphipod crustaceans, heteropods, pteropods, salps, and pyrosomes. Another significant group of carnivores are the various larval and immature forms, both holoplanktonic (planktonic at all stages of its life cycle) and meroplanktonic (organisms which have planktonic reproductive stages), from several phyla. These include most of the crustaceans mentioned, tunicates, echinoderms, cephalopods, ectoprocts, sponges, and annelid and nemertean worms. Fish larvae are important carnivores, and the survival of larvae of commercial species has an obvious economic impact. During the LOOP (1975) studies, copepods were the most abundant members of zooplankton population offshore in all sampling months, comprising between 52%-97% of the monthly totals, with an average of 79%. *Acartia* was the most numerous copepod genus at all sampling depths and its representation was rather constant at each depth. Overall, this crustacean made up 53% of the copepod population. It was followed in abundance by *Paracalanus* which comprised 28% of the copepods sampled. On the basis of 144 samples collected during three seasons, the zooplankton of the south Texas continental shelf waters were investigated to determine their abundance in terms of biomass and showed a consistent decrease seaward. This decrease was particularly pronounced in the spring and summer months when the zooplankton production was high at the shallow stations. This correlated with what was reported by LOOP (1975) and SUSIO (1976). The seasonal change of the zooplankton in both biomass and species composition was progressively extensive from the deep to shallow stations. Copepods were the most abundant group, comprising about 70% of the zooplankton by number. A total of 182 species of copepods were found, of which *Paracalanus indicus*, *P. quisimoto*, and *Clausocalanus furcatus* were most abundant. Floating patches of sargassum provide food and habitat for a large variety of animals, many of which may not be normally associated with the surface waters of the open Gulf. As with the phytoplankton, it is impossible to generalize about specific location and extent of concentrations of zooplankton due to the extreme patchiness of the phytoplankton, on which many zooplankters feed.

### (2) Benthos

For a more detailed discussion of the benthic communities of the Gulf of Mexico, see Section III.B.2. of the Final Regional EIS and Section III.B.2. of the Final EIS for Sales 94/98/102 (USDI, MMS, 1984). The benthic communities of the OCS are distributed largely by sediment type and water depth. Factors which also control the occurrence of benthic organisms are salinity, temperature, currents, and food availability. The benthos has both floral and faunal components, the floral representatives being algae and seagrasses. The abundance of benthic algae is limited by the scarcity of suitable rocky substrates and light penetration. Bright and Rezak (1976) have recorded algae from submarine banks off Louisiana and Texas. In exceptionally clear waters, benthic algae are known to grow in at least 183 m of water, especially corralline red algae (and noncorralline red algae as well). Representatives of the four major phyla of algae (*Cyanophyta*, blue-green; *Rhodophyta*, red; *Phaeophyta*, brown; and *Chlorophyta*, green) may be found in suitable locations, but in offshore waters, red and brown algae predominate. Offshore seagrasses are not conspicuous in the Western Gulf. Seagrasses would be continuous around the entire periphery of the Gulf if it were not for the adverse effects of low salinity and turbidity of the Mississippi River effluent from the delta to Galveston. The benthic faunal representatives offshore include almost all animal phyla. The benthic fauna is composed of infauna (animals that live in the substrate such as burrowing worms and molluscs) and epifauna (animals that live on the substrate such as molluscs, crustaceans, hydroids, sponges, anemones, and corals). The commercial shrimps, Penaeus spp., and demersal fishes are closely associated with benthic communities. The demersal fishes include such commercially important species as flounders, snappers, groupers, and croakers. The trophic interactions of the continental shelf have not been extensively studied. Rogers (1977) described the trophic interrelationships of demersal fishes in the northern Gulf of Mexico and postulated two food chains for the shelf benthos - a planktonic chain involving conversion of energy fixed by phytoplankton to zooplankton for utilization by higher consumers and a benthic chain involving conversion of energy fixed in organic detritus to detritus feeders for utilization by consumers in the sediment and eventually consumers in the water column. Darnell et al. (1983) have expanded upon this idea.

The area is characterized by a series of "topographic highs" which are geologic features rising out of 100-200 m to various depths and trending east-west along the shelf break. Many of these are the surface expressions of salt domes; nearly all are hard, rocky outcrops; many are drowned coral reefs. The hard, high relief surfaces provide habitat and food for a wide variety of organisms. It has been found, largely through BLM/MMS-funded studies, that at similar depths all these banks contain similar biological communities. The East and West Flower Garden Banks off Texas and Louisiana rise closer to the water's surface than the others and are the only two which contain living coral reefs. For complete descriptions of these biologically important areas, see Bright and Pequegnat (1974), Bright and Rezak (1976, 1978a, 1978b, and 1981), and Texas A&M Research Foundation (1982 and 1983).

Because of their particular sensitivity, the interest shown in them, and the fact that at similar depths the other banks show similar biologic zonation, the Flower Garden Banks are often used to describe the biological communities of the topographic highs of the Gulf of Mexico.

In addition to the generally clear water banks rising out of deepwater described above, the OCS off south Texas harbors a different type of bank. From Freeport south, where the shelf break turns to the south, deep and clearwater features are not found; rather, a series of low relief banks rising only 10-20 m in 60-80 m water depth are located father up the shelf. Compared to the other banks of the Western Gulf, these banks have depauperate flora and fauna (Bright and Rezak, 1978a). More sediments are found on the banks and the water is generally more turbid than that found at the Flower Garden Banks. These banks, while important biologically, are not nearly as rich and diverse as those others (Bright and Rezak, 1976 and 1978a).

There are a total of 23 banks in the Western Gulf which are considered biologically sensitive. None of these banks except the Flower Gardens, however, contain coral reefs, probably because none reach as close to the surface as do the Flower Gardens. These banks include: Mysterious, Blackfish, Dream, Southern, Hospital, North Hospital, Aransas, South Baker, Baker, Big Dunn Bar, Small Dunn Bar, 32 Fathom, Stetson, Claypile, Applebaum, Coffee Lump, West Flower Garden, East Flower Garden, MacNeil, Geyer, Elvers, 28 Fathom, and 29 Fathom Banks. Both 28 Fathom Bank and 29 Fathom Bank are on the line dividing the Central Gulf from the Western Gulf and therefore are considered in both. It should be noted that the emphasis on these biologically sensitive areas is not meant to imply that the rest of the Gulf of Mexico bottom is devoid of important biological resources. The shrimp fishery alone, which is concentrated over shallow, soft bottom areas, demonstrates the importance of the general Gulf bottom. Defenbaugh (1976) and Rogers (1977) document this importance. However, the soft bottom areas are large, and the biota thereof are adapted to the fine sediments, turbidity, and disturbances that result from shrimp trawling. The hard bottom areas are small (in aggregate) comprising only about 50,195 acres, or approximately 0.087% of the area, generally free of turbidity, contain coarser sediments, and are more sensitive to the types of perturbations likely to be caused by oil and gas operations (i.e., turbidity due to drilling fluids, mechanical damage due to the placement of platform and pipelines, and smothering by drill cuttings). Thus, the main concern regarding potential damage is for the hard bottom communities.

### (3) Fish Resources

Recreationally and commercially important species include brown and white shrimp, blue crab, spotted and silver seatrout, Atlantic croaker, red and black drum, southern and Gulf kingfish, sheepshead, and southern flounder. The estuaries and associated grass beds and marshes act as nursery grounds and adult feeding and harvesting areas for these species as well as for many others. Tidal passes serve as major migration routes for the movement of estuarine-dependent species to and from estuarine nursery grounds. The topography of the continental shelf in this portion of the Gulf of Mexico is relatively complex with numerous rock and coral outcrops as well as oil and gas platforms and sunken ships. These reefs attract such species as red snapper, greater amberjack, great barracuda, jewfish, and grouper (Beccasio et al., 1982).

### (4) Marine Mammals

About 19 species of marine mammals have been reported to occur in or migrate through the area (Schmidly, 1981). Those which occur in coastal waters are primarily small cetaceans (porpoises and dolphins) and, occasionally, large cetaceans (whales). The bottlenose dolphin is the most common small cetacean which occurs in Western Gulf waters. Apparently, there are two groups of bottlenose dolphins -- small discrete populations that inhabit coastal areas and offshore populations that congregate in large groups. Bottlenose dolphins occur in bays, inland waterways, ship channels, and nearshore waters. Aerial surveys indicate about 1 dolphin/1.9 mi (1 dolphin/4.9 sq.km.) offshore Brownsville, Texas (Fritts et al., 1983). Surveys offshore Texas reported about 1,000-5,000 dolphins (Orr, 1977). Dolphins usually occur in herds of 3-7 animals, but large herds of 200-600 dolphins have been observed. Spotted, striped, and spinner dolphins are other small cetaceans which occur in the Western Gulf continental shelf waters. Short-finned pilot and pygmy sperm whales occur in the deeper slope and oceanic waters.

Usually, the larger whale species inhabit the continental slope and deep oceanic waters. Sperm whales have been sighted offshore Brownsville, Texas (Fritts et al., 1983). Occasionally whales are found beached along the coast (Schmidly, 1981).

### (5) Coastal and Marine Birds

The beaches and coastal wetlands of the areas are inhabited by several migrant and nonmigrant coastal bird species consisting primarily of three general groups: shorebirds, wading birds, and waterfowl. Feeding and nesting areas include beaches, coastal bays, and other coastal wetland areas. Reproductive activity for these groups occurs from February through August (Portnoy, 1977 and Clapp et al., 1982). The Western Gulf coastal wetlands are an overwintering site for about 4-7 million migratory waterfowl (Bellrose, 1976). The peak of the fall migration is November-December and spring migration occurs from March to early May. The major waterfowl habitats are coastal bays and wetland areas. The national wildlife refuges and state wildlife management areas provide important feeding, nesting, and resting areas for many of these migratory waterfowl. Waterfowl hunting in the Western Gulf coast wetlands is an important source of recreation and income. FWS has produced a "Gulf Coast Ecological Inventory" and a set of 22 (1:250,000 scale) maps which are excellent sources of information pertaining to coastal bird species along the Western Gulf coast (Beccasio et al., 1982).

Marine birds, such as gulls, terns, boobies, petrels, and shearwaters, occur in the Gulf continental shelf area (Murphy, 1976 and Clapp et al., 1982). Aerial surveys offshore Brownsville, Texas, found 24 species of marine birds and 91% of all marine birds sighted were gull and tern species (Fritts et al., 1983). Marine birds primarily feed and roost offshore, coming ashore for nesting or when storms blow them inshore. Generally, the largest concentrations of marine birds are found near upwelling areas (near the continental slope edge) and other areas of high productivity. Because of their marine habits, population and distribution, data for marine birds are limited.

### (6) Endangered and Threatened Species

Five federally listed endangered whale species occur. These include the finback, humpback, right, sei, and sperm whales. Usually, these large cetaceans inhabit the continental slope and deep oceanic waters (Schmidly, 1981). Sperm whales have been sighted offshore Brownsville, Texas (Fritts et al., 1983).

Red wolf hybrids occur along the coast in Jefferson County, Texas; for all practical purposes, pure-blood red wolves are extinct in the wild (McCarley and Carley, 1979).

Three federally listed endangered turtle species (hawksbill, Kemp's ridley, and leatherback turtles) and two threatened species (green and loggerhead turtles) occur. The green turtle is listed as endangered in Florida waters and threatened throughout the rest of the northern Gulf. The hawksbill turtle inhabits reefs, shallow coastal areas, and passes in water less than 20 m deep. The Kemp's ridley turtle inhabits shallow coastal and estuarine waters. Kemp's ridley turtles infrequently nest on the beaches of southwestern Padre Island, Texas, where FWS, NMFS, and NPS have established a ridley turtle head start release program. The leatherback turtle is the most pelagic sea turtle and may be found near the continental shelf edge. Sightings have been reported along the Gulf coast in March and April; no recent nesting has been reported in the Gulf. The green turtle is found throughout the Gulf where its favored habitats are lagoons and shoals providing an abundance of marine grass and algae on which it feeds. No recent green turtle nesting has been reported along Gulf beaches. The loggerhead turtle occurs throughout the Gulf. They nest on various barrier islands and beaches.

The American alligator occurs generally throughout the area in fresh to brackish water coastal areas. In coastal areas of Texas, the alligator is listed as "threatened by similarity of appearance."

A small population of brown pelicans occurs near Corpus Christi, Texas, and small numbers of brown pelicans from Mexico feed along the southwestern coast of Texas during the summer. The habitat of these colonial nesters are small coastal inlands in salt and brackish water areas. The red-cockaded woodpecker occurs primarily in mature open pine forests in Eastern Texas. Arctic peregrine falcons migrate along the Gulf coast of Texas. Some peregrine falcons overwinter along the Gulf coastal area. Bald eagles inhabit several Gulf coastal counties in Texas. Small discrete populations of Attwater's prairie chicken occur in the coastal prairie of the mid-Texas coast. A small population (about 70-80) of migratory whooping cranes overwinters at the Aransas National Wildlife Refuge and surrounding wetland areas from October through April.

No Federally listed endangered plant species are known to occur in the Western Gulf coastal area. Additional information on endangered and threatened species for the Gulf region can be found in the FWS and NMFS biological opinions in the Final EIS for Gulf of Mexico Lease Sales 94/98/102 (USDI, MMS, 1984).

### (7) Estuaries and Wetlands

The following habitat types are characteristic: estuarien open water and bottoms, seagrass beds, barrier islands, mangroves, nonforested wetlands (tidal marshes), forested wetlands, and terrestrial habitats. Marshes and mangroves form an interface between marine and terrestrial habitats, while seagrass beds occupy a transition zone between emergent vegetation and unvegetated estuarine open water. Forested wetlands are found inland from marsh areas. The above habitats usually occur in bands parallel to the coast and consist of sharply delineated zones of different species, or mixed plant species communities. Coastal habitats are highly productive for a great number and a wide variety of invertebrates, fish, herpetofauna, birds, and mammals. The central origin of biologic productivity on the

Gulf coast are the vegetated estuarine habitats; primarily the mangroves, marshes, seagrass beds, and forested wetlands. In the Western Planning Area there are collectively approximately 3.12 million acres of the above described habitats; approximately 1.24 million acres are vegetated wetlands.

### (8) Areas of Special Concern

The topographic features of the Western Gulf, including the East and West Flower Garden Banks, constitute a series of biologically sensitive areas containing unique coral reef and/or coral reef communities. The Flower Garden Banks are the only examples of extensive tropical Caribbean coral reef communities found in the northern Gulf. Over 250 species of benthic invertebrates and more than 100 fishes inhabit the bank. Above 25-29 m the bank is covered with a thriving submerged coral reef which, except for its total lack of shallow-water alcyonarians, is a good example of the Diploria-Montastrea-Porites community so common on reefs in the Caribbean and southern Gulf. In addition, the bank harbors sizable knolls occupied almost entirely by populations of the small branching coral Madracis mirabilis. Finger-sized remains of dead Madracis are extremely important components of the sediment on and adjacent to the reef. In some cases the coarse carbonate sand which typically occurs between coral heads in the Diploria-Montastrea-Porites Zone is entirely supplanted by Madracis rubble.

### (9) Marine Sanctuaries

No marine sanctuaries have been established in the area. The Flower Garden Banks have been designated as an Active Candidate in the process taken by NOAA leading to sanctuary designation (49 FR 30988-30991 of August 2, 1984). This site is located 110 mi (160 km) offshore, consisting of east and west sections approximately 16 mi (25 km) apart and representing the northernmost coral reef community in the Western Gulf of Mexico. The proposed borders of the sanctuary encompass a total of 44 sq.mi.(114 sq.km.). The area is a valuable representation of a tropical coral reef community dominated by hermatypic coral (Montastrea annularis, M. cavernosè, Porities asteriodes, and Diploria strigosa) and associated reef fishes and invertebrates.

Baffin Bay, Texas, was placed on the Site Evaluation List (a step prior to that of Active Candidate) in 48 FR 35568-35577 (August 4, 1983). This site is not on the OCS, but is a bay-estuary system separated from the Gulf by a barrier island.

## c. Socioeconomic Environment

### (1) Employment and Demographic Conditions

The region includes the coastal portion of Texas from Orange County in the east to Cameron County in the west. The Standard Metropolitan Statistical Areas (SMSA's) which occur in this socioeconomic impact area are, in east to west order:

| SMSA | 1983 Average Annual Employment |
|---|---|
| Beaumont-Port Arthur-Orange | 155,600 |
| Galveston-Texas City | 80,400 |
| Houston | 1,587,400 |
| Victoria | 34,500 |
| Corpus Christi | 149,400 |
| Brownsville-Harlinger-San Benito | 77,400 |

### (2) Coastal Land Use and Water Services

The shoreline, consisting of bays, estuaries, and a vast barrier island system, stretches for 2,500 miles. The shoreline and wetlands are mostly undeveloped. Numerous small communities serving tourist and commercial fishing interest exist. The most urbanized areas are Galveston and Corpus Christi. The largest port facilities on the coast are located on Galveston Island Bolivar Peninsular. The Port of Houston is located inland of the shoreline.

The coastal segment of Texas depends heavily on its surface and groundwater resources for industrial, municipal, and agricultural uses. Rapid increases in urbanization and industrialization along the coastal area have drastically reduced its water supply. Present withdrawals in the Houston-Galveston area exceed the region's aquifer recharge capacity. Heavy pumpage of coastal aquifers has introduced problems concerning salt-water intrusion and subsidence in many of the coastal counties of the state. The pumpage of large quantities of groundwater in the Houston-Galveston region of Texas has resulted in declines in artesian pressure, further resulting in pronounced regional subsidence of the surrounding land surface. Several reports have described this subsidence as a result of the permanent compaction of fine-grained clay strata in the subsurface caused by loading due to pressure declines associated with the removal of subsurface fluids, primarily water, oil, and gas. As this phenomenon occurs, the overlaying land surface tends to sink, resulting in lowering area elevations, changing surface gradients, and the activation of faults. The results are changes in drainage patterns, which aggravate flooding problems in the coastal areas and pose an increased risk of catastrophic flooding due to hurricane tidal surges. The greatest water supply problems exist in the lower Rio-Grande Valley where the annual rainfall rates are less than 24 inches and surface water rights are about 100% appropriated. One of the remedies to the freshwater consumption needs of the Texas coastal zone has been the construction of several reservoir dams throughout the state; however, though these have aided in meeting the vast water consumption needs of the coastal zones, various side effects have added to existing water quality problems in these areas. Reduction of flow into estuarine systems aids in reduction of flushing and lengthens the time that pollutants remain in the bays and estuaries of the region.

### (3) Commercial Fisheries

Based on the NMFS landings data for 1977-1981 (Tidwell, 1983) approximately 179.9 million pounds of finfish and shellfish (excluding freshwater species) are landed annually in the Western Gulf with an annual dockside value of $148.8 million. From the standpoint of both sales and volume, the production of shellfish overwhelms all other commercial fishing. In 1978, shrimp, blue crab, and oyster accounted for about 95% of the total landings of 98.7 million pounds and 98% of the total value of $147.9 million. Shrimp accounted for 85.2% of the volume and 95.3% of the value; blue crabs for 7.6% of the volume and 1.4% of the value; and oysters for 1.9% of the volume and 1.5% of the value (Liebow et al., 1980).

The major commercial finfish in Texas are red drum, spotted seatrout, red snapper, black drum, and flounder. In 1977 the commercial catch for red drum was 948,000 pounds, worth $510,000; spotted seatrout totaled 1.4 million pounds, worth $672,000; red snapper totaled 269,000 pounds, worth $246,000; black drum totaled 1.5 million pounds, worth $398,000; two species of flounder totaled 307,000 pounds, worth $266,000 (Liebow et al., 1980).

There are over 6,600 commercial fishermen on the Texas coast where processed fisheries products amounted to over $151 million. The main processed fishery products are shrimp, oysters, and crabs (USDC, NMFS, 1980).

### (4) Recreation and Tourism

The northern Gulf of Mexico coastal zone is one of the major recreational regions of the United States, particularly in connection with marine fishing and beach-related activities. The coastal beaches, barrier islands, estuarine bays and sounds, river deltas, and tidal marshes are extensively and intensively utilized for recreational activity by residents of Texas, the Gulf south and tourists from throughout the nation, as well as from foreign nations. Publicly-owned and administered areas such as Padre Island National Seashore, state parks, beaches, wildlife lands, historic and natural sites, landmarks, and scenic rivers attract visitors throughout the year. Commercial and private recreational facilities and establishments, such as resorts, marinas, amusement parks, and ornamental gardens, also serve as primary interest areas and support services for people who seek enjoyment from the recreational resources associated with the area.

It has been determined that two broad categories of recreational resources/activities are susceptible to direct and potentially significant impacts from OCS leasing and development: (a) offshore recreational fishing; and (b) major shorefront recreational beaches. For a detailed definition, description, and discussion of these resource categories and their relative importance within the planning area see Volume 1, Section III.C.10. and Visuals No. 4, 10, and 14 of the Final EIS for Lease Sale 94/98/102 (USDI, MMS, 1984).

According to data from the Texas Tourist Development Agency, total travel expenditures in the Texas Gulf region were about $4.7 billion in 1982, or 34.2% of the comparable state total. These expenditures provided over

96,000 jobs to Texas residents with payrolls of about $986 million. Related state and local tax receipts for the WPA in 1982 were over $107 and $61 million, respectively. About 91% of the Texas Gulf region's travel expenditures occurred in major metropolitan areas that are in close proximity to popular Texas Gulf beaches, specifically in Cameron, Galveston, Harris, Jefferson, and Nueces Counties.

### (5) Archaeological Resources

Based on information provided by the archaeological resources baseline study (CEI, 1977), supplemented by information from the quarterly Defense Mapping Agency printout of Nonsubmarine Contacts, MMS records show 17 confirmed shipwrecks. It should be emphasized that hundreds of other ships from all historic periods are known to have gone down in the Western Gulf; however, information on the location of these reported wrecks is not sufficient to allow mapping.

Rock outcrops, salt diapirs, fluvial channels, floodplains, terraces, point bars, natural levee ridges, bays, estuaries, and lagoons are all features which occur, and which have a high potential for the occurence of associated prehistoric sites. Preservation of site materials would be very good in association with floodplains, fluvial terraces, bays, estuaries, and lagoons where sites have been buried in a low energy environment prior to the marine transgression of the area. The thin covering of Holocene marine sediments across the eastern portion of the Western Gulf would permit recovery of site information; however, the thickness of archaeologically sterile open-shelf Holocene marine sediments in the western portion of the area may preclude recovery of site information in the underlying strata.

### (6) Marine Vessel Traffic

Marine vessel traffic visiting ports made up about 23% of the total Gulf of Mexico (GOM) Region traffic in 1981. A portion of this traffic was involved in activities associated with the exploration, development, and production of oil and gas in the Gulf. A number of ports have developed into important centers for offshore support. The most active of these are, from east to west, Sabine Pass, Port O'Connor, and the Ingleside-Aransas Pass-Port Aransas area.

The area contains a major USCG-administered safety fairway system that prvides obstruction-free access to the ports of Port Arthur, Galveston/Houston, Freeport, Port Lavaca/Port O'Connor, Corpus Christi/Ingleside-Aransas Pass-Port Aransas area, and Brownsville. Many shallower draft vessels travel the Gulf Intracoastal Waterway (GIWW) which follows the coastline inshore and through bays and estuaries linking important ports.

### (7) Military Uses

Thirty-seven percent, or 12,000,000 acres, of water and air space of the Western Gulf of Mexico is used for the various military operations within two warning areas. Warning area 602 is used extensively from the surface to 45,000 feet for a myriad of training profiles that include live firing aerial gunnery, trailing wire antenna activity, flares and chaff drops/tests, and B-52 G-model low level flights. However, the Air Force has not indicated an intensive use of W-602. Because it lies mostly over deeper waters, Warning Area 602 has had oil and gas development only in the northern one-third of the area. Warning Area 228 has been intensively used by the Navy for carrier manuevers and carrier pilot training, and has had considerable oil and gas activity take place within it. These areas are shown in Figure III.B.1.C.-1.

| Warning Areas | Defense Operations Conducted |
|---|---|
| W-228 | Air-to-air gunnery, rocket firing, aircraft carrier operations, submarine operations |
| W-602 | High altitude training |

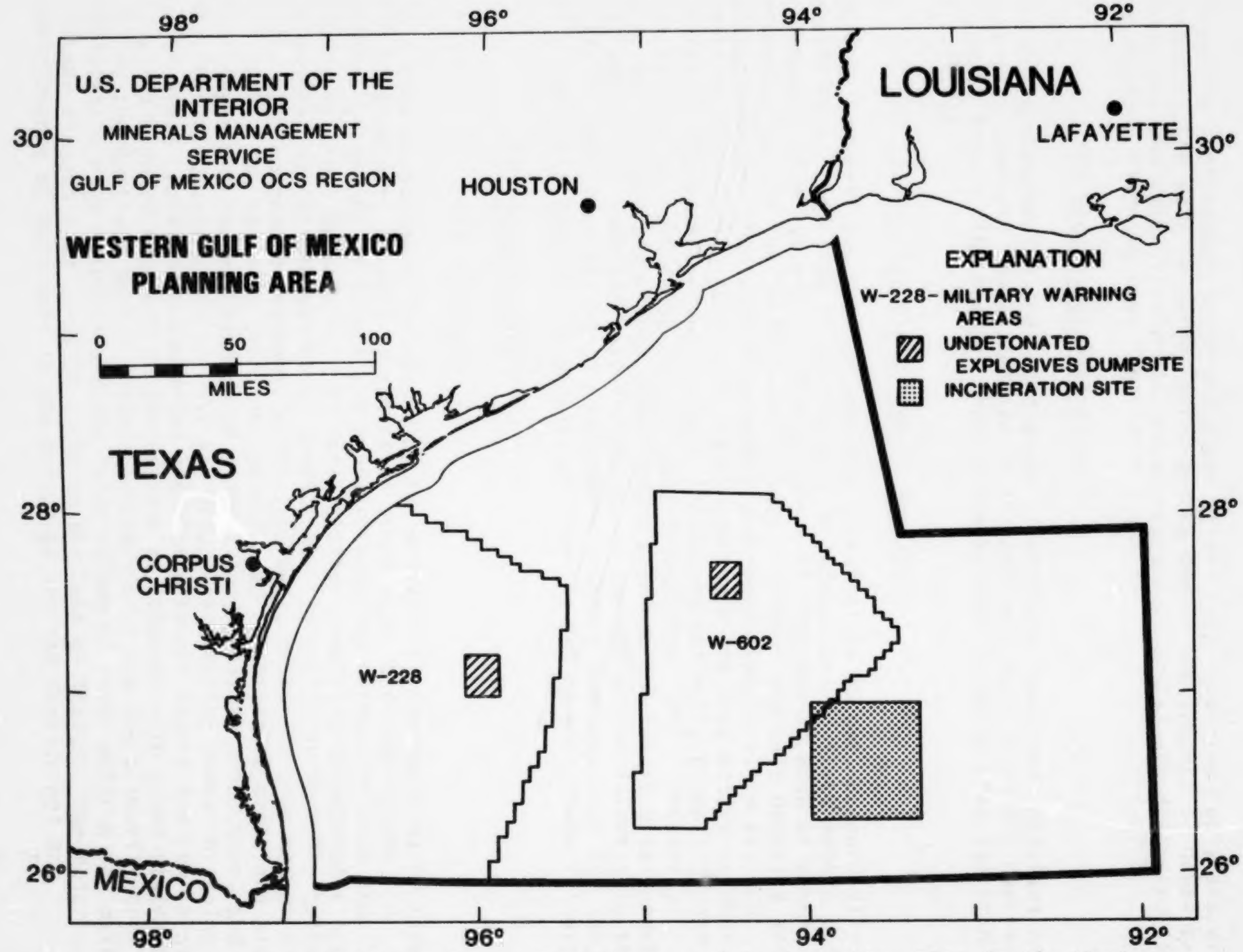

98°
96°
94°
92°
30°
28°
26°
U.S. DEPARTMENT OF THE INTERIOR
MINERALS MANAGEMENT SERVICE
GULF OF MEXICO OCS REGION
WESTERN GULF OF MEXICO PLANNING AREA
0
50
100
MILES
LOUISIANA
LAFAYETTE
HOUSTON
TEXAS
CORPUS CHRISTI
MEXICO
EXPLANATION
W-228 - MILITARY WARNING AREAS
▨ UNDETONATED EXPLOSIVES DUMPSITE
▦ INCINERATION SITE
W-228
W-602

Figure III.B.1.c.1. Military Areas, Dumpsites, and Incineration Site in the Western Gulf of Mexico.

## 2. Central Gulf of Mexico

### a. Physical Environment

#### (1) Geology

Since the continental shelf and slope of offshore Texas and Louisiana are generally the same in period stratigraphy and in the process of development, the geologic structures, processes, and potential are discussed in the Western Planning Area (Section B.1.a.(1)).

#### (2) Geological Hazards

Since the continental shelf and slope of offshore Texas and Louisiana are generally similar, the discussion of the geologic hazards of the Central Planning Area is the same as that of the Western Planning Area (Section B.1.a.(2)).

#### (3) Non-Petroleum Mineral Resources

Several minerals now are, or have the potential to become, commercially exploitable. Deposits of quartz sand in Federal and in State waters off the coasts of Mississippi and Alabama are of interest because of their potential use in the production of glass. Sulphur and salt deposits associated with the thousands of diapiric and domed structures in the OCS seafloor have mining potential. Although there are five active sulphur leases in OCS waters, none of these leases are currently producing, and a new sulphur or salt lease has not been issued since 1967. Presently, supplies onshore and within state waters preclude the future development of OCS deposits. Sand and gravel deposits on the OCS are of interest to the State of Louisiana for beach nourishment projects and have been the subject of a Louisiana request for permission from the MMS to mine these resources.

#### (4) Oceanography

##### (a) Chemical

This area is strongly influenced by the presence of America's major river, the Mississippi, as well as a host of other major drainage sytems. A complex geography of sounds and bays protected by barrier islands and extensive tidal marshes acts to delay mixing, resulting in extensive areas of mesohaline (middle salinity) conditions. Turbidity is normally quite high, with suspended sediments up to 1-10 mg/l, primarily composed of clay minerals. The salinity gradients established in estuarine areas are extremely important for maintenance of finfish and shellfish production, and enormous fluctuations in harvest may occur, paralleling annual hydrology. In general, Louisiana's estuaries and near offshore waters are low in salinity and high in nutrient concentrations as compared with other states bordering the northern Gulf. These characteristics are due primarily to Louisiana's high rainfall and the large volume of river water which makes its way through rich alluvial soils to the Gulf of Mexico. The major contributors of nutrients to the estuaries are the Mississippi and

Atchafalaya Rivers. Within the nearshore area, sediment trace metal values may show high absolute concentrations or anomalous ratios due to the input of contaminated clays borne by the Mississippi. Transition metals known to be used/disposed of during heavy industrial processes, such as mercury and cadmium, are likely contaminants.

The Mississippi River input acts to create a lens of fresher, more turbid water, often curling to the west. Hydrographic studies, suspended sediment characteristics, and sensitve chemical analyses demonstrate its influence as far west as South Texas. Of importance is the water-column stratifying effect of this fresh lens on nearshore waters. It is frequently observed during summer months that anoxic bottom water conditions exist on the central Louisiana shelf. Mass mortality of organisms and characteristic chemical changes also occur. These conditions have serious implications for monitoring programs of any sort. As a probable consequence of the large fluvial input of nutrients, the Louisiana nearshore shelf is considered one of the most productive areas of phytoplankton in the Gulf. Integrated chlorophyll values are two times average Gulf values, and integrated production values range an order of magnitude greater than the Gulf average.

Less is known about the nature of offshore waters in the central area than other zones. Observations indicate that the effects of the Mississippi are felt here, although much reduced by distance. Anoxic bottom waters are not reported, although surface freshening occurs at times of maximal discharge. Upwelling of cooler, nutrient-rich waters onto the shelf is known, but the mechanism is not fully understood, since regional circulation patterns remain unclear. The passage of detached, anticyclonic eddies toward the west may be important in this regard. The water column is frequently observed to contain turbid layers associated with interfaces between two or three distinct water layers. Mississippi River origin is suggested for these layers. No studies have been identified which characterize this specific region. It is believed that values for productivity and chlorophyll approach Gulf averages, but that circulation events, such as the transient effects of passing eddies, might play a role in enhancing these values.

### (b) Physical

The shelf circulation is influenced mostly by tides, local winds, and freshwater discharge form local river sytems. Although the tides and the winds are not typically strong (0.5 m to 8 m/sec, respectively) except during the occurrence of an extreme event (tropical storm), the combined effect of wind and tide produces irregular and unpredictable circulation that can be quite strong. Off coastal Alabama, studies have found the alongshore motion to be predominatly wind-driven. The year to year variability in the wind makes a net flow in either alongshore direction possible. When the alongshore motion has been observed in the easterly direction, there has been a persistent offshore motion observed also (Chuang et al., 1982). Other phenomena, such as high-volume river discharge, has been associated with onshore (cross shelf) motion in several areas.

Studies of the Mississippi Sound area show the long-term averages of surface and bottom currents as indicators of circulation in the Mississippi Sound. In the passes between barrier islands, mean surface flow is out of the sound, and bottom currents are either weak, in the same direction, or directed into the Sound. The circulation in the Sound is thought to be dominated by several horizontal circulation gyres, clearly undefined to date. For more information, see "Mississippi Sound and Adjacent Areas" (U.S. Army Corps of Engineers, 1983). Other studies off the Mississippi River indicate that Loop Current activity occasionally influences and induces high velocity currents to approximately 300 m in the immediate area (Collipp et al., 1975). It has also been suggested that the Loop influences shelf circulation off the Alabama coast.

### (5) Water Quality

The area is characterized by many water quality problems that are affected by the discharge or release of industrial wastes and domestic sewage into its rivers, bays, and estuaries. The most signficant source of pollution in this area is the outflow from the Mississippi River which drains more than 5.5 million sq.km. or 41% of the lands of the continental United States. This drainage results in the presence of high bacterial concentrations and toxic pollutants within the Mississippi River area and is evidenced by high levels of organic pollutants found in its deltaic sediments. Other contributions to water quality problems within this region stem from increased land clearing activities associated with agriculture, industry and urbanization, dredging and disposal of dredge spoils, and industrial/domestic pollution from numerous point source discharges along the coast. These activities have led to the eutrophication of several coastal water bodies in Louisiana and the permanent and temporary closure of many shellfishieries in the region.

### (6) Ocean Dumping

There are no EPA approved ocean dumping sites. There are, however, dredged material disposal sites adjacent to dredged channels. Some of these sites may extend to the OCS and may receive considerable quantities of material.

### (7) Climate

This area is influenced by the same climatic patterns as the Western Gulf. Precipitation averages 137 cm at New Orleans, Louisiana. Dense, peristent fog occurs more frequently during the late winter or early spring in the Mississippi River delta region than in other parts of the Gulf because of the Mississippi River runoff reacting with the warmer Gulf waters.

### (8) Air Quality

Air Quality of the coastal area along the Gulf of Mexico is measured against the Natinal Ambient Air Quality Standards (NAAQS) resulting from the Clean Air Act as amended. These standards are designed to preserve the air quality of an area at a threshold necessary to protect public health and welfare.

The ambient air quality in any area is determined by utilizing special monitoring schemes (40 CFR 50) and is measured relative to NAAQAS' primary and secondary standards. Primary standards are designed to protect public health, and secondary standards are designed to protect public welfare. If a county or section of a county does not meet the primary and/or secondary standards, they are classified as nonattainment. Areas designated as Prevention of Significant Deterioration areas are identified as mandatory Class I Federal Areas wehre visibility is an important value. These areas are national and international parks and wilderness areas.

Air quality in the coastal region of the Gulf is generally considered good and in many areas is better than the national standards. Of the two Alabama counties bordering the Central Gulf of Mexico (CGOM), one is a clean air county, while the other county exceeds primary standards for ozone (OX) and both primary and secondary standards for TSP in the urban areas.

There are three (3) coastal counties in Mississippi and all are clean air counties.

There are fourteen (14) coastal parishes in Louisiana. Seven parishes are clean air parishes, while the remaining seven parishes exceed standards for ozone (OX).

There are no PSD Class I areas in the CPA (Breton Wilderness Area) whereby a small amount of degradation to ambient air quality is considered significant. All nonattainment areas in the CPA area identified below:

St. John the Baptist, Louisiana
  Nonattainment - Primary - OX
Orleans, Lousiana
  Nonattainment - Primary OX
Jefferson, Louisiana
  Nonattainment - Primary - OX
St. Bernard, Louisiana
  Nonattainment - Primary - OX
Lafourche, Lousiana
  Nonattainment - Primary - OX
St. Mary, Louisiana
  Nonattainment - Primary - OX
Mobile, Alabama
  Nonattainment - Primary - OX
St. Charles, Louisiana
  Nonattainment - Primary - OX

All three states have State Implementation Plans for air quality coupled with regulatory enforcement and monitoring programs in operation.

Ambient air quality is considered to be a function of the size, distribution, and activity of a population and, more importantly, the industrialization of an area. Emissions from all sources, such as external combustion, solid waste incineration, internal combustion, evaporation, chemical processing, etc., make up the ambient air quality at any given time according to the particular rate of dispersion. These factors preclude the ambient air quality form remaining the same at all times and, in fact, work in unison such that peak and low conditions are observed as a function of time; i.e., at certain periods the controlling factors may cause the ambient air quality to meet or exceed NAAQS and at other times it may be far below. Meteorological conditions play a very important role in the dispersion of emissions, and thus, on the ambient air quality. Generally, long range transport of emissions will cause worst-case onshore conditions when a plume is traveling in a stable layer (strong inversion) over water, the winds are persistent in reaching shore, and unstable daytime conditions occur over coastal areas. These conditions area rare in the coastal Gulf Regions due primarily to prevailing meteorological and physiological characteristics.

### b. Biological Environment

#### (1) Plankton

See Section III.B.1.b.(1), the Western Gulf, for a discussion of plankton.

#### (2) Benthos

See Section III.B.2.b.(2) for a brief generic discussion of the benthos of the Gulf of Mexico. Conditions in this area are quite similar to that of the Western Gulf described in Section III.B.1.b.(2)--topographic highs containing biologically important communities.

There are 16 banks (topographic highs) which are considered biologically sensitive because they exhibit the same or similar biological communities as the Flower Garden Banks (FGB) at similar depths. None of these banks, however, contain coral reefs, probably because none of them reach as close to the surface as do the FGB. These banks include: Sackett, Rezak, Diaphus, Sidner, Ewing, Bouma, Jakkula, Sonnier, Sweet, 18 Fathom, Fishnet, Bright, Alderdice, 28 Fathom, Parker, and 29 Fathom Banks.

It should be noted that the emphasis on these biologically sensitive areas is not meant to imply that the rest of the Gulf of Mexico bottom is devoid of important biological resources. The shrimp fishery alone, which is concentrated over shallow, soft bottom areas, demonstrates the importance of the general Gulf bottom. Defenbaugh (1976) and Rogers (1977) document this importance. However, the soft bottom areas are large, and the biota thereof are adapted to the fine sediments, turbidity, and disturbances. The hard bottom areas are small (in aggregate comprising only about 21,263 acres, or approximately 0.055% of the area, generally free of turbidity, contain coarser sediments, and are more sensitive to the types of perturbations likely to be caused by oil and gas operations (i.e., turbidity due to drilling fluids, mechanical damage due to the placement of platforms and pipelines, and smothering by drill cuttings). Thus, the main concern regarding potential damage is for the hard bottom communities.

Of the total seafloor videotaped and photographed between 20-200 m, approximately half was initially categorized as sand bottom/soft bottom. This sand over hard substrate was intermixed with the sand bottom/soft bottom across all transects. Taken together these two substrate categories accounted for nearly 90% of the total.

Additional observations included phenomena such as turbidity fronts and seafloor depressions or pockmarks. Turbidity fronts were observed during fall and spring and appeared to be related to resuspension of bottom sediments. Pockmarks ranged in diameter from 1-25 m and were generally less than 2 m in depth. Their origin remains unknown but may reflect either the presence of underwater springs or buried karst features. Mass movements of sand waves and sediments are currently being investigated during the continuation of this study.

In the soft bottom areas, photographic data indicated that macrophytes were widely distributed. In terms of average percent coverage, _Caulerpa_ spp. were dominant, comprising nearly 60% of the total vegetated areas. The number of species found at each station was low, ranging from one to eight and averaging from three to four species. Although 50% fewer species were observed in the spring, no clear temporal patterns were evident.

Fish collections in the fall yielded 99 taxa; in the spring, 77 taxa. Fifty-eight taxa were common to both collections. The more abundant fish taxa were distributed throughout the study area, and faunal composition was similar from station to station. Little seasonal variation in faunal composition was detected between fall and spring. Visual observation indicated generally low epifaunal abundances at soft bottom stations. Trawl data further substantiated these observations, although a number of soft bottom stations had isolated sponges and corals present. Clustering analyses of trawl data (epibiota and fishes) revealed distinct onshore-offshore bathymetric distribution patterns but little latitudinal variation in faunal composition. No distinctive trends in temporal variation were indicated from the analyses. Infaunal taxonomic richness was extremely high, 1,033 taxa being identified from almost 56,000 organisms collected. Excluding meiofaunal components (nematodes, ostracods, and copepods), eight taxa were considered dominants in the study area: Oligochaeta, Nemertina, five polychaete, and a bivalve. The southernmost offshore station yielded the greatest number of taxa during both cruises. In general, deeper water stations (greater than 60 m) on each transect exhibited greater taxonomic richness than inner shelf stations. Latitudinal and seasonal variations in taxonomic richness were minimal. Infaunal richness values were considerably higher than those recorded during previous investigations on the southwest Florida shelf. In contrast to infaunal richness, total infaunal density appears to be inversely related to depth; i.e., deeper stations generally exhibit lower faunal densities. Temporal variations were occasionally pronounced in nearshore areas, but did not substantially affect relative abundances among major faunal groups. In general, low biotal coverages were found at a majority of the live bottom stations.

### (3) Fish Resources

Commercially important species include brown and white shrimp, Gulf menhaden, blue crab, eastern oyster, Atlantic croaker, red and black drum, spotted and sand seatrout, striped mullet, and southern and Gulf flounder. Recreationally important species include spotted seatrout, red drum, tarpon, Florida pompano. red snapper, and Spanish mackerel. Most of the important species in this area are estuarine dependent. The seagrass beds numerous estuaries, and vast tidal marshes, especially around the Mississippi River Delta from Chandeleur Sound through Atchafalaya Bay, provide prime nursery grounds for these species. Reefs are primarily artificial, composed of oil and gas platforms, and attract many species of fish including red snapper, spadefish, cobia, bluefish, groupers, and Spanish mackerel (Beccasio et al., 1982).

### (4) Marine Mammals

About 26 species of marine mammals have been reported to occur in or migrate through the area (Schmidly, 1981). Those which occur in coastal waters are primarily small cetaceans (porpoises and dolphins) and occasionally large cetaceans (whales). Appparently, there are two groups of bottlenose dolphins--small discrete populations that inhabit coastal areas and offshore populations that congregate in large groups. Bottlenose dolphins are fairly common. Aerial surveys offshore Marsh Island, Louisiana, indicate about 1 dolphin/1.4 sq.mi. (1 dolphin/3.7 sq.km.) (Fritts et al., 1983). Aerial surveys of the Louisiana-Mississippi coastal waters reported about 2,000-6,000 bottlenose dolphins (Leatherwood and Platter, 1975).

Dolphins usually occur in herds of 3-7 animals, but large herds of 200-600 animals have been observed. Spotted, striped, and spinner dolphins are other small cetaceans which occur in the CPA continental shelf waters. Short-finned pilot and pygmy sperm whales occur in the deeper slope and oceanic waters. Usually, large cetaceans inhabit the continental slope and deep oceanic waters (Schmidly, 1981). Sperm whales have been sighted near the Louisiana Delta (Fritts et al., 1983). All marine mammals are protected under the Marine Mammal Protection Act of 1972.

### (5) Coastal and Marine Birds

The beaches and coastal wetlands are inhabited by several migrant and nonmigrant coastal bird species consisting primarily of three general groups: shorebirds, wading birds, and waterfowl. Feeding and nesting areas include beaches, coastal bays, and other coastal wetland areas. Reproductive activity for these groups occurs from February through August (Portnoy, 1977 and Clapp et al., 1982). Portnoy (1977) recorded 847,000 birds of 26 species in habitats ranging from swamp forest to coastal marshes and barrier islands; the most abundant species were the Louisiana heron, snowy egret, and cattle egret. The coastal wetlands are the overwintering site for about 2-4 million migratory waterfowl (Bellrose, 1976). The peak of the fall migration is November-December, and spring migration occurs from March to early May. The major waterfowl habitats are coastal bays and wetland areas. The national wildlife refuges and state wildlife management areas provide important feeding, nesting, and resting areas for many of these migratory waterfowl. Waterfowl hunting along the coast is an important source of recreation and income. During the 1977-1978 waterfowl season 676,000 hunter-days were recorded for the Louisiana coastal area.

Marine birds, such as gulls, terns, boobies, petrels, and shearwaters, occur in the continental shelf region (Murphy, 1967 and Clapp et al., 1982). Aerial surveys offshore Marsh Island, Louisiana, found 25 species of marine birds and 96% of all marine birds sighted were gull and tern species (Fritts et al., 1983). Marine birds primarily feed and roost offshore, coming ashore for nesting or when storms blow them inshore.

Generally, the largest concentrations of marine birds are found near upwelling areas (near the continental slope edge) and other areas of high productivity. Because of their marine habitats, population and distribution data for marine birds are limited.

### (6) Endangered and Threatened Species

Five Federally listed endangered whale species occur in the area. These include the finback, humpback, right, sei, and sperm whales. Usually, these large cetaceans inhabit the continental slope and deep oceanic waters (Schmidly, 1981). Sperm whales have been sighted near the Louisiana Delta (Fritts et al., 1983).

Red wolf hybrids occur along the Gulf coast in Cameron Parish, Louisiana; for all practical purposes, pure-blood red wolves are extinct in the wild (McCarley and Carley, 1979).

Three federally listed endangered turtle species (hawksbill, Kemp's ridley, and leatherback turtles) and two threatened species (green and loggerhead turtles) occur. The hawksbill turtle inhabits reefs, shallow coastal areas, and passes in water less than 20 m deep. No recent hawksbill nestings have been reported in the Central Gulf. The Kemp's ridley turtle inhabits shallow coastal and estuarine waters. The leatherback turtle is the most pelagic marine turtle and may be found near the continental shelf edge. Sightings have been reported along the Gulf coast in March and April; no recent nesting has been reported in the Gulf. The green turtle is found throughout the Gulf where its favored habitats are lagoons and shoals, providing an abundance of marine grass and algae on which it feeds. No recent green turtle nesting has been reported along the Gulf beaches. The loggerhead turtle wanders widely throughout the Gulf and infrequent nesting occurs on the Chandeleur Islands off Louisiana.

The American alligator occurs generally throughout the area in fresh to brackish water coastal areas. In coastal areas of Louisiana, the alligator is listed as "threatened by similarity of appearance."

Three small brown pelican nesting areas (about 9,000-10,000 birds) occur at North Island in northern St. Bernard Parish and Queen Bess Island in Louisiana and another nest site occurs in Mobile Bay near Theodore, Alabama. The habitat of these colonial nesters are small coastal inlands in salt and brackish water areas.

A small population of nonmigratory Mississippi sandhill cranes inhabits an area in Jackson County, Mississippi. The red-cockaded woodpecker occurs primarily in mature open pine forests. Bald eagles inhabit several coastal counties in the area.

No federally listed endangered plant species are known to occur in the Central Gulf coastal area. Additional informaton on endangered and threatened species for the Gulf region can be found in the FWS and NMFS biological opinions in the Final EIS for the Gulf of Mexico Lease Sales 94/98/102 (USDI, MMS, 1984).

### (7) Estuaries and Wetlands

The following habitat types are characteristic: estuarine open water and bottoms, seagrass beds, barrier islands, mangroves, nonforested wetlands (tidal marshes), forested wetlands, and terrestrial habitats. Nonforested and forested wetlands form an interface between the marine and terrestrial habitats. Seagrass beds are limited to the least turbid areas. The above habitats usually occur in bands parallel to the coast and consist of sharply delineated zones of different species or mixed plant species communities. Plant production in lowest in estuarine open water and greatest in forested wetlands. Coastal habitats are highly productive for a great number and a wide variety of invertebrates, fish, herpetofauna, birds, and mammals. The central origin of biologic productivity on the Gulf coast is the vegetated estuarine habitats; primarily the mangroves, marshes, seagrass beds, and forested wetlands. There are collectively approximately 18.24 million acres of the above described habitats; approximately 4.57 million are vegetated wetlands (Visual No. 14 of Draft EIS 94/98/102). The projected rate of land loss in coastal Louisiana for the early 1980's is approximately 50 sq.mi. per year (Boesch, 1982).

### (8) Areas of Special Concern

A series of biologically sensitive areas contain unique coral reef and/or coral reef communities. In the region of the shelf break, the Central Gulf is characterized by a series of "topographic highs" which are geologic features rising out of 100-200 m to various depths and trending east-west along the break. Many of these are the surface expression of salt domes, and nearly all are hard, rocky outcrops; many are drowned coral reefs. The hard, more or less vertical surfaces provide habitat and food for a wide variety of organisms. It has been found that at similar depths all these banks contain similar biological communities. The East and West Flower Garden Banks off Texas and Louisiana rise closer to the water's surface than the others and are the only two which contain living coral reefs.

### (9) Marine Sanctuaries

No marine sanctuaries have been established; however, the Shoalwater Bay-Chandeleur Sound area off Louisiana is on the NOAA Site Evaluation List. This site includes approximately 80 sq.mi. (207 sq.km.) of state waters, including shallow water seagrass beds and algae located upon a subsiding remnant of abandoned Mississippi River Delta. Adjacent to the east of this site is the Breton National Wildlife Refuge. This site is not located on the OCS.

## c. Socioeconomic Environment

### (1) Employment and Demographic Conditions

The area includes the coastal portions of Louisiana, Mississippi, and Alabama as well as inland counties/parishes where offshore oil and gas support activities are known to exist or offshore-related petroleum industries are established. The SMSA's included in this region are, from east to west:

| SMSA | 1983 Average Annual Employment |
|---|---|
| Mobile | 170,100 |
| Pascagoula-Moss Point | 40,100 |
| Biloxi-Gulfport | 61,500 |
| New Orleans | 462,600 |
| Baton Rouge | 212,300 |
| Lafayette | 93,700 |
| Lake Charles | 64,000 |

Non-SMSA 1983 employment of 224,000 accounts for 17% of employment in the region. The region had a labor force of 1,505,600 in the same year. Based on 1981 Department of Commerce data, employment in this region is concentrated in trade, services, and manufacturing; however, manufacturing holds a lower relative share of the labor market in Louisiana than in Alabama or Mississippi. Overall population growth over the 1978-1981 period amounted to about 8%, while over the same period, total personal income and per capita personal income increased by 53% and 37%, respectively. (For a complete listing of counties/parishes and a more detailed discussion of the Socioeconomic Environment, see Final EIS 94/98/102, Section III.)

### (2) Coastal Land Use and Water Services

Louisiana's coast consists of vast areas of wetlands interlaced with many streams and channels. The wetlands extend landward from the shore from 5-30 miles and offer very little beach recreation. Industrialized areas are concentrated in areas more suited to development and support commercial fishing, oil and gas activities, and small rural communities. There is limited agricultural land use in the area. Mississippi's coastal areas consist of offshore barrier islands, some wetlands, recreational beaches, and intensive urban development serving both tourists and residential interest. Alabama's coastal area has many small residential communities and numerous motels accommodating seasonal tourists.

The area abounds in surface and groundwater resources with plentiful supplies of fresh surface water due to the high rainfall rates and upstream runoff into the coastal basins. Rain surplus, coupled with favorable geologic conditions, has enabled extensive groundwater aquifers to develop throughout this region. Although plentiful water supplies abound here, continuous and cyclical groundwater pumpage takes place throughout the Central region, and in the last few decades declining water levels have reversed the direction of the hydraulic gradient in many areas aquifers, resulting in saltwater intrusion. Although there are numerous cases of saltwater intrusion throughout this region, surface water surpluses aid in maintaining the freshwater head necessary in preventing serious saltwater intrusion problems.

### (3) Commercial Fisheries

Based on NMFS landings data for 1977-1981 (Tidwell, 1983) approximately 1.5 billion pounds of finfish and shellfish (excluding freshwater species), with an annual dockside value of over $281 million, are caught annually.

Approximately 89 million pounds of shrimp, worth $99 million, and over 1 billion pounds of menhaden, worth over $50 million, are landed annually in Louisiana; 11 million pounds of shrimp, worth $11 million, and 232.3 million pounds of menhaden, worth $11 million, in Mississippi; and 25 million pounds shrimp, worth $34 million, in Alabama. Other important fishery resources include oysters, crabs, and many finfish species.

In 1976, there were approximately 12,160 commercial fishermen on the Louisiana coast where processed fishery products amounted to about $191.3 million. The main processed fishery products were shrimp, menhaden, oysters, and crabs (USDC, NMFS, 1980).

### (4) Recreation and Tourism

The northern Gulf of Mexico coastal zone is one of the major recreatonal regions of the United States, particularly in connection with marine fishing and beach-related activities. The coastal beaches, barrier islands, estuarine bays and sounds, river deltas, and tidal marshes are extensively and intensively utilized for recreational activity by residents of the Gulf South and tourists from throughout the nation, as well as from foreign countries. Publicly-owned and administered areas such as Gulf Islands National Seashore, state parks, beaches, wildlife lands, as well as specially designated preservation areas such as historic and natural sites and landmarks, wilderness areas, wildlife sanctuaries, and scenic rivers attract visitors throughout the year. Commercial and private recreational facilities and establishments, such as resorts, marinas, amusement parks, and ornamental gardens, also serve as primary interest areas and support services for people who seek enjoyment from the recreational resources associated with the Gulf of Mexico.

It has been determined that three broad categories of recreational resources/activities are susceptible to direct and potentially significant impacts from OCS leasing and development: (a) offshore recreational fishing; (b) major shorefront recreational beaches; and (c) designated environmental preservation areas. For a detailed definition, description, and discussion of these resource categories and their relative importance see Volume 1, Section III.C.10. and Visuals No. 4, 10, and 14 of the latest Regional EIS (USDI, MMS, 1984).

According to data from the Alabama Bureau of Publicity and Information (1982), tourist-related travel expenditures in Alabama amounted to $2.7 billion in 1982. Such travel expenditures generated more than 65,000 jobs, as well as $104 million in state retail sales tax collections, excluding gasoline tax receipts. About 11% of the travelers cited Alabama Gulf coast beaches as their destination.

Data from a study prepared for FWS and BLM (Larson et al., 1980) indicates that tourism along the Mississippi Gulf coast involves about 2.9 million out-of-state visitors annually. In 1982, Gulf region sales at tourist-related establishments such as hotels, motels, and restaurants exceeded $211 million, and state gasoline tax receipts from Gulf region travelers were over $2.7 million, based on information from the University of Southern Mississippi's Bureau of Business Research. Of the four counties that comprise the study region, Harrison County is responsible for about 65% of these sales and tax receipts. The main Gulf coast tourist attractions include the white sand beach along the Pass Christian-Biloxi stretch of the coast and the Gulf Island National Seashore area. In 1982, the Gulf Island National Seashore received 600,000 visitors.

Data from the U.S. Travel Data Center (1983) indicates that in the Louisiana Gulf region, travel expenditures amounted to over $2.7 billion in 1982, representing about 85% of comparable statewide expenditures. Over $555.4 million, or 20% of the region's total expenditures, served as payrolls to about 61,000 employees. Also, state and local tax receipts from these travel expenditures equalled $84.0 and $48.7 million, respectively. Over 67% of the study region's travel expenditures occur in Orleans Parish. Unlike tourism in other parts of the Gulf region, very little activity is associated with Gulf beaches; instead, major attractions include a variety of sports events, festivals, conventions, and sightseeing activities.

### (5) Archaeological Resources

Based on information provided by the archaeological resources baseline study (CEI, 1977), supplemented by information from the quarterly Defense Mapping Agency printout of Nonsubmarine Contacts, MMS records show 51 confirmed shipwrecks. It should be emphasized that hundreds of other ships from all historic periods are known to have gone down; however, information on the location of these reported wrecks is not sufficient to allow mapping.

Rock outcrops, salt diapirs, fluvial channels, floodplains, terraces, point bars, natural levee ridges, bays, estuaries, and lagoons are all features which occur and which have a high potential for the occurrence of associated prehistoric sites. Preservation of site materials would be very good in association with floodplains, fluvial terraces, bays, estuaries, and lagoons where sites have been buried in a low energy environment prior to the marine transgression of the area. The thin covering of Holocene marine sediments would permit recovery of site information; however, areas of most active deposition from the Mississippi River would be an exception.

### (6) Marine Vessel Traffic

Marine vessel traffic visiting ports made up about 68% of the total GOM Region traffic in 1981. A significant portion of this traffic was involved in activities associated with the exploration, development, and production of oil and gas in the Gulf. A number of ports have developed into important centers for offshore support. The most active of these are, from east to west, Venice, Morgan City, Intracoastal City, and Cameron.

The area contains a major USCG-administered safety fairway system that provides obstruction-free access to Mobile, Pascagoula, Biloxi, the Mississippi River, Lake Charles, and the Louisiana Offshore Oil Port (LOOP) which is located 20 miles offshore Lafourche Parish. LOOP is a deepwater oil terminal that facilitates the offloading of imported oil from tankers too large to visit coastal ports. Many shallower draft vessels travel the GIWW which follows the coastline inshore and through bays and estuaries, linking important ports.

(7) Military Uses

Ten percent, or 4,078,000 acres, of water and air space is used for the various military operations within three warning areas and one water test area. Warning area 453 is an Air National Guard training area, and Warning Area 92 is a Naval Air Reserve training area. In both areas use is infrequent and intermittent (Figure III.B.2.c.1.).

An intensive use of W-92 or W-453 or the water test area has not been indicated by the Navy or Air Force in the past. All three areas have had very little oil and gas development. Warning area 155 is used by the Navy for carrier maneuvers and carrier pilot training. Although W-155 has had very little oil and gas development within it, the Navy has indicated that W-155 has a continuous and intensive use, and that the Navy is concerned that future oil and gas exploration and development facilities may seriously restrict their operations in the area. These areas are shown in Figure IIIBC-1.

Figure IIIBC-1

| Warning Areas | Defense Operations Conducted |
|---|---|
| W-92 | Air-to-air gunnery, rocket firing, sonar buoy operations |
| W-453 | Air National Guard training |
| W-155 | Carrier maneuvers, carrier pilot training |
| EWTA-1 | Rocket and missile testing and research |
| EWTA-3 | Rocket and missile testing and research |

## 3. Eastern Gulf of Mexico

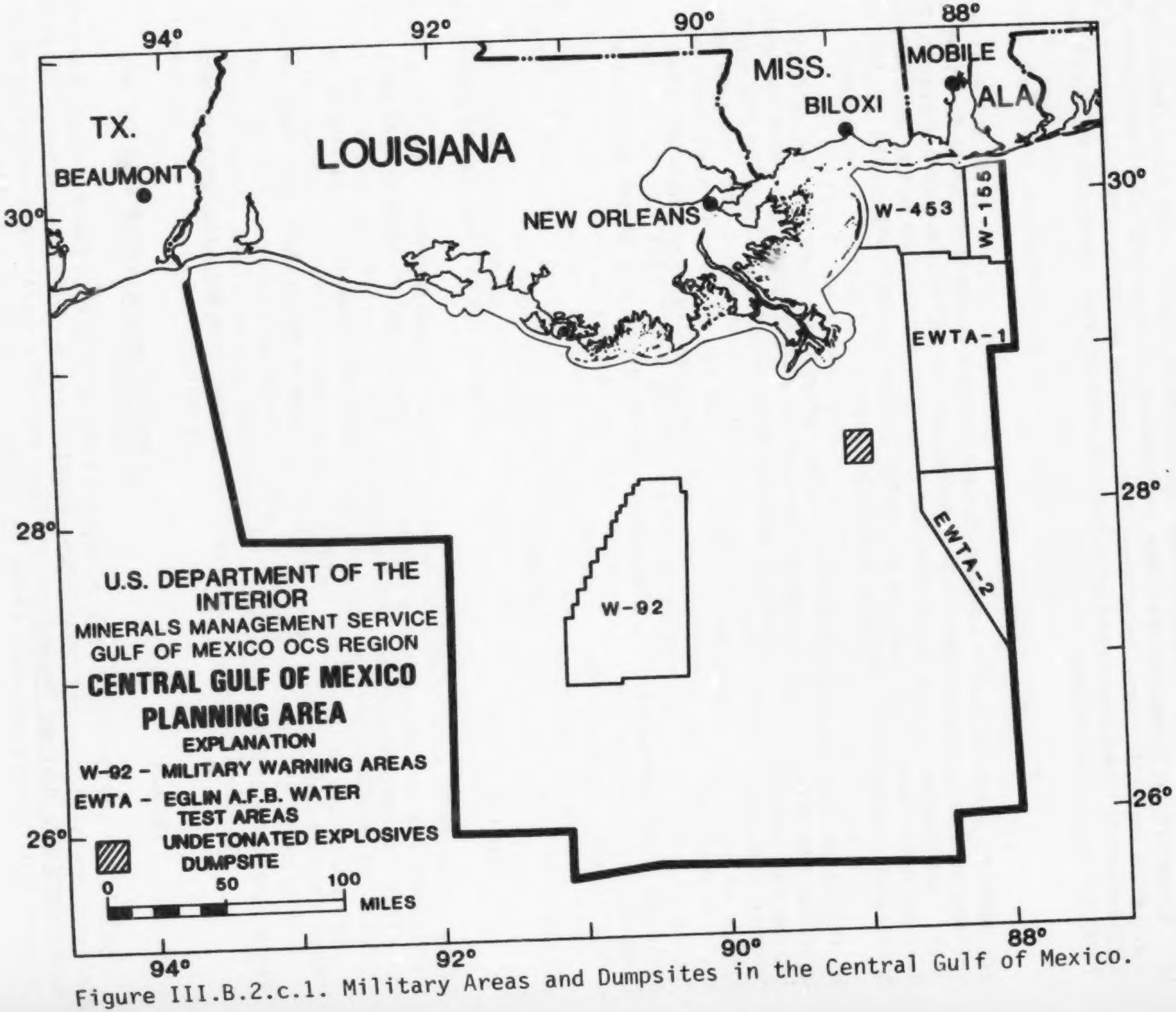

94°
92°
90°
88°
30°
28°
26°
TX.
BEAUMONT
LOUISIANA
MISS.
BILOXI
MOBILE
ALA
NEW ORLEANS
W-453
W-155
EWTA-1
EWTA-2
W-92
U.S. DEPARTMENT OF THE INTERIOR
MINERALS MANAGEMENT SERVICE
GULF OF MEXICO OCS REGION
CENTRAL GULF OF MEXICO
PLANNING AREA
EXPLANATION
W-92 - MILITARY WARNING AREAS
EWTA - EGLIN A.F.B. WATER TEST AREAS
▨ UNDETONATED EXPLOSIVES DUMPSITE
0
50
100
MILES

Figure III.B.2.c.1. Military Areas and Dumpsites in the Central Gulf of Mexico.

## a. Physical Environment

### (1) Geology

The continental shelf margin of the area is dominated by the Florida Platform, consisting of a massive sequence of carbonate and evaporite deposits of Mesozoic and Cenozoic ages. The West Florida Platform is characterized by nearly horizontal carbonate strata with a thin covering of Pleistocene and Holocene sediments. The area has several regional scale structural features, including the Apalachicola Embayment, the Ocala Uplift, and the South Florida Basin. Within these large regional structures there are several well-known smaller features, such as the Florida Middle Ground, the Tampa Arch, and the Southwest Florida Reef Trend, and there are many lesser known arches, anticlines, and basins. At the edge of the West Florida Platform, there are numerous shelf edge filled embayments and several basin structures behind the shelf edge reef complexes. Major potential exploration targets in the area are stratigraphic pinchouts, shelf margin reef facies, and structural traps associated with salt tectonics, growth faults, and minor anticlines.

### (2) Geologic Hazards

The only geologic hazard is the presence of karst features in the carbonate strata. Pressurized gas within karst is rare; therefore, the chances of blowouts are minimal. Callapse of a doline feature is possible, and if an oil or gas structure is located directly over the feature, such a collapse could present a risk of an oil spill or loss of a structure or well. Industry has now had three years of experience in the karst areas and has not encountered problems with rig siting or drilling.

### (3) Non-Petroleum Minerals Resources

The major mineral resource of the West Florida Platform is phosphate deposits. Although phosphate deposits are known to exist, the economic climate has not been supportive enough of surveys and testing to determine the extent, the quantity, the quality, and the depth of burial of the deposits. Given the proper economic incentives, industry has indicated it would be interested sufficiently to further evaluate the resources and to develop the recovery technology. At present, there are no plans or proposals for mining non-petroleum mineral resources.

### (4) Oceanography

#### (a) Chemical

The major influence on this zone is atmospheric forcing combined with the seasonal input from fluvial sources. Pockets of high salinity water (greater than 36.8 ppt) may be found on the bottom, possibly produced by enhanced evaporation during the summer. Very rarely, Loop Current waters may intrude landward of the 20-m contour bringing nutrient rich waters. In general, resident waters remain nutrient deficient with the exception of the immediate vicinity of estuaries. Oxygen values are at or near saturation, and profiles show little structure. Outside the estuaries, productivity values are low. Extraordinary blooms of toxic phytoplankton, known as "red tide," may occur on the mid- to inner-shelf. These outbreaks may be associated with Loop Current intrusions, the flux of initiatory substances from estuaries, or both.

The major influence in this zone is undoubtedly the pervasive influence of the Loop Current. It is fairly well-established that the current acts to pump nutrient-rich, deep waters up onto the shelf. This mechanism acts most demonstrably during the passage of frontal eddy structures and may be enforced by wind-driven upwelling. Near-bottom increases in particle content are a usual condition, but the explanation consists of a complex summation of occasional bottom current effects and enhanced productivity at depth. Less is known about the hydrography of the outer shelf in the area of the De Soto Canyon. Loop Current intrusions are infrequent occurrences here, but may have major impacts on nutrient chemistry. Both chlorophyll and productivity values at the surface are normally low in this area, with the signficant exception of patches of enhanced activity occurring within the upwelled parcels of colder waters found in the cyclonic interior of frontal eddies. Chlorophyll and productivity values about an order of magnitude greater are probably the usual condition near the bottom of the euphotic zone, due to the intruded, nutrient-rich Loop undercurrent waters.

### (b) Physical

The more localized circulation in the broad shelf region is influenced by tides, local winds, freshwater input, and some influence from open Gulf circulation features acting as a forcing mechanism on shelf areas. Winds and tides together are the major contributors to shelf circulation; however, at times, wind-driven water may completely mask all tidal-induced circulation. Additionally, the Loop Current often influences local circulation in shelf areas where it impinges on the shelf or where a Loop Current eddy interacts with the shelf as a forcing mechanism. It has been demonstrated through remote sensing activities that the Loop Current frequently influences outer shelf activity in several ways. This is first done by acting as a direct forcing mechanism at times when the Loop meanders shoreward along its eastern boundary. That same activity also normally causes cool shelf and slope water to be transported westerly many kilometers seaward of the shelf and eventually to move out of the area. Additionlly, several investigators have linked this activity with upwelling events along the west Florida shelf. It has also been found that these activities can act as a rapid transport mechanism from the west Florida shelf to the east coast of Florida.

A recently completed circualtion modelling study of the southwest Florida shelf indicates the general circulation patterns for this area. Winter circulation is in the southerly direction on the outer half of the shelf at all levels of the water column with a typical velocity of 10 cm/sec. On the mid and inner shelf, the model shows a general trend of upwelling where bottom waters flow in the onshore direction (southeast to east), and surface waters consequently flow in the offshore direction (westerly near shore and southwesterly at mid shelf).

Spring and summer circulation is similar to winter in that the general trend of upwelling where bottom waters flow is in the onshore direction (southeast to east), and surface waters consequently flow in the offshore direction (westerly near shore and southwesternly at mid shelf).

Spring and summer circulation on the outer shelf and near the Loop Current boundary is southerly or southwesterly. However, the surface component of the circulation inshore clearly indicates a northerly coastal jet extending from Key West to Apalachicola. The velocity of this jet is shown to be approximately 5 cm/sec in the spring and twice that (10 cm/sec) in summer (USDI, MMS, 1982).

Gulf of Mexico tides are small and noticeably less developed than many other coastal areas of the Atlantic or Pacific coasts. The ranges of tides throughout the Gulf are typically on the order of 0.3-1.2 m depending on the location and time of year. The type of tide differs considerably throughout the Gulf. In some locations, the tide is of a diurnal nature while in others, it may be semidiurnal or both. The major tide variations are keyed to the declination of the moon. There are inequalities which yield a mixed tide from some particular areas and considerable inequality in the heights of high and low waters with a difference of only a few tenths of a foot at times. For additional information on the Loop Current, refer to "An Environmental Guide to Ocean Thermal Energy Conversion (OTEC) Operations in the Gulf of Mexico" (USDC, NOAA, 1983).

### (5) Water Quality

Overall, those estuaries found in the northwest Florida area exhibit the best water quality. The majority of water problems in this area stem from high coliform concentrations and have resulted in the temporary closure of several shell fisheries. The most serious water quality problems existing on west coast of Florida occur in the Tampa Bay area, which is characterized as a large, shallow estuarine system with restricted tidal flushing and encompassing a 3,000 sq.mi. drainage area. Land use in the area adjacent to the bay is primarily urban with major sources of pollution resulting from domestic sewage, industrial effluents, and urban stormwater runoff from the metropolitan areas.

### (6) Ocean Dumping

There are no EPA approved ocean dumping sites. There are, however, dredged material disposal sites adjacent to dredged channels. Some of these sites may extend to the OCS and may receive considerable quantities of material.

### (7) Climate

The Eastern Gulf is influenced by the same climatic patterns as the Western and Central Gulf areas. Precipitation averages range from 163 cm in Pensacola, Florida, to 102 cm at Key West, Florida.

### (8) Air Quality

Air quality of the coastal area along the Gulf of Mexico is measured against the National Ambient Air Quality Standards (NAAQS) resulting from the Clean Air Act as amended. These standards are designed to preserve the air quality of an area at a threshold necessary to protect public health and welfare.

The ambient air quality in any area is determined by utilizing special monitoring schemes (40 CFR 50) and is measured relative to NAAQAS' primary and secondary standards. Primary standards are designed to protect public health, and secondary standards are designed to protect public welfare. If a county or section of a county does not meet the primary and/or secondary standards, they are classified as nonattainment. Areas designated as Prevention of Significant Deterioration areas are identified as mandatory Class I Federal Areas where visibility is an important value. These areas are national and international parks and wilderness areas.

Air quality in the coastal region of the Gulf is generally considered good and in many areas is better than the national standards. Of the 22 coastal counties bordering the Central Gulf of Mexico, 19 are clean air counties. Three counties, one also exceeds primary and secondary standards for Sulfur Oxides (SOX) and another exceeds the secondary standards for Total Suspended Particulate (TSP).

There are three PSD Class I areas in Florida. They are the Chassahowizha Wilderness Area, Everglades National Park and St. Marks Wilderness Areas. All are within standards. All nonattainment areas in the EPA are identified below.

Hillsbourough, Florida
  Nonattainment - Primary - OX

Pinnellas, Florida
  Nonattainment - Secondary - TSP

Dade, Florida
  Nonattainment - Primary - OX

The State of Florida has a State Implementation Plan for air quality coupled with regulatory enforcement and monitoring programs in operation.

Ambient air quality is considered to be a function of the size, distribution, and activity of a population and, more importantly, the industrialization of an area. Emissions from all sources, such as external combustion, solid waste incineration, internal combustion, evaporation, chemical processing, etc., make up the ambient air quality at any given time according to the particular rate of dispersion. These factors preclude the ambient air quality from remaining the same at all times and, in fact, work in unison such that peak and low conditions are observed as a function of time; i.e., at certain periods the controlling factors may cause the ambient air quality to meet or exceed NAAQS and at other times it may be far below. Meteorological conditions play a very important role in the dispersion of emissions, and thus, on the ambient air quality.

Generally, long range transport of emissions will cause worst-case onshore conditions when a plume is traveling in a stable layor (strong inversion) over water, the winds are persistent in reaching shore, and unstable daytime conditions occur over coastal areas. These conditions are rare in the coastal Gulf Regions due primarily to prevailing meteorological and physiological characteristics.

### b. Biological Environment

#### (1) Plankton

See Section III.B.1.b.(1) for a discussion of plankton.

#### (2) Benthos

The existence of live bottom areas on the Florida shelf has been known for some time and is important in at least two respects: it has intrinsic value as a very productive habitat for a wide variety of organisms, including algae, sponges, and corals; and it provides habitat for several commercially important fish species (indeed, fishermen are attracted to "hard grounds" because of the good fishing). Unfortunately, these areas are often small and scattered in what appears to be a random manner.

Nine biological assemblages were identified between depths of 20-200 m. These nine assemblages are: (a) Inner and Middle Shelf Sandbottom; (b) Inner Shelf Live Bottom; (c) Inner and Middle Shelf Live Bottom; (d) Middle Shelf Algal Nodule; (e) *Agaricia* Coral Plate; (f) Outer Shelf Sand Bottom; (g) Outer Shelf Crinoid; (h) Outer Shelf Prominences Live Bottom; and (i) Outer Shelf Low Relief Live Bottom Assemblages. Two of these assemblages (the two Sand Bottom Assemblages) were soft bottom related; the other seven were live bottom assemblages. Soft bottom assemblages had an attached macroepifaunal density which was generally less than one individual per sq.mi.; live bottom assemblages had much higher macroepifaunal densities.

These biological assemblages were associated with five substrate categories: (a) Rock Outcrops/Hard Bottom: typically, this bottom type included relatively localized rock ledges or exposed low-relief rocky areas covered by distinctive indicator epibiota; (b) Thin Sand Over Hard Substrate: this bottom type, transitional between Rock Outcrops/Hard Bottom and Sand Bottom/Soft Bottom, consisted of a thin veneer of sand covering a more consolidated (hard) substrate. The presence of key biological organisms such as larger gorgonians and sponges that had to be attached to the buried hard substrate was used to identify this bottom type; (c) Sand Bottom/Soft Bottom: this is a morphologically variable bottom type which encompassed a number of forms including open planar bottoms, areas of sand waves and ripples, bioturbated areas, and soft bottoms covered with algae. Sediment grain size and chemical composition were variable; constituents ranged from quartz clastics to carbonate muds; (d) Coralline Algal Nodule Layer over Sand: this bottom type consisted of patches of corralline algal nodules and rubble covering soft bottom areas. It was usually found in water depths greater than 60 m; (e) Algal Nodule Pavement with *Agaricia* Accumulations: this bottom type was similar to the

Coralline Algal Nodule Layer over Sand described above, but differed in having a fused coralline algae-dead hard coral pavement overgrowing a soft bottom.

### (3) Fish Resources

Species of commercial and recreational importance include groupers, snappers, sea bass, grunts, bluefish, king and Spanish mackerel, and pink, brown, and white shrimp. Estuarine-dependent species include pink, brown, and white shrimp, blue crab, easter oyster, bay scallop, bay anchovy, spotted and sand seatrout, Atlantic croaker, red and black drum, spot, southern kingfish, sheepshead, southern and Gulf flounder, and Gulf menhaden. Reefs provide important habitats for many important fishes including snappers and groupers. Oceanic species that occur within this area include groupers, jacks, snappers, mackerels, and billfish.

Off southwest Florida, some of these same species as well as some additional species become important. Commercially important species include pink shrimp, stone crab, spiny lobster, Spanish and king mackerel, white and striped mullet, several grouper and snapper species, spotted sand and seatrout, and Florida pompano. Important sport species include bonefish, red drum, sheepshead, tarpon, snook, cobia, ladyfish, sailfish, dolphin, greater amberjack, and blue and white marlin.

The vast estuaries, tidal marshes, seagrass beds, and mangrove swamps of southwest Florida serve a major function as breeding, nursery, and feeding grounds for fish such as tarpon, ladyfish, snook, sheepshead, members of the drum family, and mullets (Beccasio et al., 1982).

### (4) Marine Mammals

About 25 species of marine mammals have been reported to occur in or migrate through the area (Schmidly, 1981). Those which occur in coastal waters are primarily three groups: the West Indian manatee, small cetaceans (porposies and dolphins), and occasionally large cetaceans (whales).

During the winter months manatees concentrate along the coast of peninsular Florida from the Crystal River (west coast) to Titusville (east coast). During the summer months the population, estimated to be about 800-900, disperses along the coast (Irvine et al., 1981). Manatees are usually observed in coastal waterways and prefer water depths of 1-3 m; offshore migration has not been documented.

Bottlenose dolphins are fairly common. They occur in bays, inland waterways, ship channels, and nearshore waters. Fish, primarily mullet and menhaden, are their major food source. An estimated population density of bottlenose dolphins offshore Naples, Florida, indicates about 1 dolphin/2.2 sq.mi. (1 dolphin/5.7 sq.mi.) (Fritts et al., 1983). Dolphins usually occur in herds of 3-7 animals, but large herds of 200-600 dolphins have been observed. Spotted, striped, and spinner dolphins are other small cetaceans which occur in the continental shelf waters. Short-finned pilot and pygmy sperm whales occur in the deeper slope and oceanic waters.

Usually, large cetaceans inhabit the continental slope and deep oceanic waters, occasionally whales are found beached along the coast (Schmidly, 1981). Humpback whales have been sighted off Seashore Key, Florida, and near the mouth of Tampa Bay (Gainesville Sun, March 1983).

### (5) Coastal and Marine Birds

The beaches and coastal and wetlands are inhabited by several migrant and nonmigrant coastal bird species consisting primarily of three general groups: shorebirds, wading birds, and waterfowl. Feeding and nesting areas include beaches, coastal bays, and other coastal wetland areas. Reproductive activity for these groups occurs from February through August (Portnoy, 1977 and Clapp et al., 1982). Coastal wetlands are the overwintering site for about 1-2 million migratory waterfowl (Bellrose, 1976). The peak of the fall migration is November-December, and spring migration occurs from March to early May. The major waterfowl habitats are coastal bays and wetland areas. The national wildlife refuges and state wildlife management areas provide important feeding, nesting, and resting areas for many of these migratory waterfowl.

Marine birds, such as gulls, terns, boobies, petrels, and shearwaters, occur in the continental shelf region (Murphy, 1967 and Clapp et al., 1982). Aerial surveys offshore the Naples, Florida area found 24 species of marine birds, 67% of which were tern species (Fritts et al., 1983). Marine birds primarily feed and roost offshore, coming ashore for nesting or when storms blow them inshore. Generally, the largest concentrations of marine birds are found near upwelling areas near the continental slope edge and other areas of high productivity. Because of their marine habitats, population and distribution data for marine birds are limited.

### (6) Endangered and Threatened Species

Five federally listed endangered whale species occur in the area. These include the finback, humpback, right, sei and sperm whales. Usually, these large cetaceans inhabit the continental slope and deep oceanic waters (Schmidly, 1981). Humpback whales have been sighted off the west coast of Florida (Gainesville Sun, March 1983).

During the winter months manatees concentrate along the coast of peninsular Florida from the Crystal River (west coast) to Titusville (east coast). During the summer months the population, estimated to be about 800-900, disperses along the coast (Irvine et al., 1981). Manatees are usually observed in coastal waterways and prefer water depths of 1-3 m; offshore migration has not been documented.

The key deer range is restricted to a few islands in the lower Florida Keys, chiefly Big Pine and No Name Keys. Current population is estimated to range from 400-600 deer.

Four federally listed endangered turtle species (green, hawksbill, Kemp's ridley, and leatherback turtles) and one threatened species (loggerhead turtle) occur. The green turtle is found throughout the Gulf where its favored habitats are lagoons and shoals providing an abundance of marine grass and algae on which it feeds. No recent green turtle nesting has been reported along Eastern Gulf beaches, but juvenile green turtles occur frequently along the southwest Florida coast. The hawksbill turtle inhabits reefs, shallow coastal areas, and passes in water less than 20 m deep. Recently, two hawksbill nestings have been reported for the west Florida coast. Kemp's ridley turtles have been reported. (Carr et al., 1982) They inhabit shallow coastal and estuarine waters. The leatherback turtle is the most pelagic marine turtle and may be found near the continental shelf edge. Sightings have been reported along the Gulf coast in March and April; no recent nesting has been reported in the Gulf. The loggerhead turtle occurs throughout the Gulf. They nest on various barrier islands and beaches from the Florida Keys and up the southwest Florida coast where the majority of nesting in the Gulf occurs.

The American alligator occurs generally in fresh to brackish water coastal areas. The alligator occurs in the coastal areas of Florida where it is listed as "threatened by similarity of appearance." American crocodiles are restricted to southern Florida, chiefly along Florida Bay and on adjacent Key Largo. The crocodile population is estimated to range from 200-400 animals.

The red-cockaded woodpecker occurs primarily in mature open pine forests throughout the area. Arctic peregrine falcons migrate along the eastern coast of Florida and the Florida Keys. Some peregrine falcons overwinter along the Gulf coastal areas. The majority of the bald eagle population in the Gulf coastal region occurs in Florida.

No federally listed endangered plant species are known to occur in the Eastern Gulf coastal area. Additional information on endangered and threatened species for the Gulf region can be found in the FWS and NMFS biological opinions in the Final EIS for the Gulf of Mexico Lease Sales 94/98/102 (USDI, MMS, 1984).

### (7) Estuaries and Wetlands

The following habitat types are characteristic of the area: estuarine open water and bottoms, seagrass beds, barrier islands, mangroves, nonforested wetlands (tidal marshes), forested wetlands, and terrestrial habitats. Nonforested and forested wetlands form an interface between the marine and terrestrial habitats, while seagrass beds occupy a transition zone between emergent vegetation and unvegetated estuarine open water. Forested wetlands are found inland from marsh areas. The above habitats usually occur in bands parallel to the coast and consist of sharply delineated zones of different species or mixed plant species communities. Coastal habitats are highly productive for a great number and a wide variety of invertebrates, fish, herpetofauna, birds, and mammals. The central origin of biologic productivity on the Gulf coast are the vegetated estuarine habitats; primarily the mangroves, marshes, seagrass beds, and forested wetlands. There are collectively approximately 13.65 million acres of the above described habitats; approximately 5.73 million acres are vegetated wetland (Visual No. 14 of the Final EIS for Sales 94/98/102, (USDI, MMS, 1984).

### (8) Areas of Special Concern

Live bottom areas are of concern because of their biological productivity as well as their use as fish habitat (Section III.B.3.b.(b)). The Florida Middle Ground is probably the best known of these areas.

The Florida Middle Ground represents the northermost extent of coral reefs and their associated assemblages in the Eastern Gulf. The Middle Ground is like the Flower Garden Banks off Texas - typical Caribbean reefal communities - although somewhat depauperate in terms of number of species present, probably because it is considered to be at the northern limit of viable existence for these types of coral communities. Coral reef communities are exceedingly complex and have been treated at length elsewhere. It is sufficient to state that in general, hermatypic (reef building) corals require temperatures of 18-30 degrees C with the optimum of about 26 degrees C; salinities from 36-40 ppt (parts per thousand) with the optimum at about 36 ppt; little pollution; and adequate light (i.e., little turbidity). In the Caribbean they may grow as deep as 80 m while in the Gulf they seem to be limited to a depth of about 40 m. The Middle Ground reefs rise essentially from a depth of 35 m, and the shallowest portions are about 25 m deep. Significantly productive areas comprise about 29,943 acres.

Although technically not in the area, the Florida Keys represent an area of great concern. The Florida Reef Tract of the Keys is the most extensive example of tropical coral reefs in the United States. Although the Keys have been highly developed by housing and industry, the offshore reefs remain areas of great biological productivity and beauty. For a detailed description description of the Keys, see Section III.D.2. of the Final EIS for proposed Sales 94/98/102 (USDI, MMS, 1984).

### (9) Marine Sanctuaries

No marine sanctuaries have been established in the EPA. However, the Big Bend Seagrass Beds are on the NOAA Site Evaluation List. These seagrass beds are a 100 mi productive habitat supporting a rich diversity of marine organisms including the endangered manatee. The seagrass community greatly increases the surface area available for plants and animals and provides a suitable substrate for many organisms that would not be able to colonize bare sand. In this way, the seagrass beds sustain the growth and proliferation of vast numbers of marine invertebrates and algae which interact in a delicately balanced food web that supports several commercially important species such as oysters, scallops, blue crab, stone crab, shrimp, red drum, spotted sea trout, and mullet. In addition to supporting a rich diversity of food organisms for commercially important indigenous and migratory species of finfish, detrital material derived from the seagrass beds may also provide an important source of nutrition supporting adjacent oyster reef communities.

In addition, two estuarine sanctuaries have been established in Florida: Rookery Bay and Apalachicola Bay and River National Estuarine Sanctuaries.

Two marine sanctuaries have been established on the Atlantic side of the Florida Keys: Looe Key and Key Largo National Marine Sanctuaries (see Section III.B.4.b.(9)).

### c. Socioeconomic Environment

#### (1) Employment and Demographic Conditions

The SMSA's which are located in this region are, in east to west order:

| SMSA | 1983 Average Annual Employment |
|---|---|
| Miami | 768,100 |
| Fort Myers-Cape Coral | 99,400 |
| Sarasota | 84,900 |
| Bradenton | 67,500 |
| Tampa-St. Petersburg | 717,700 |
| Tallahasse | 85,400 |
| Panama City | 42,800 |
| Pensacola | 122,400 |

Non-SMSA counties accounted for about 9% of employment in 1983, with non-SMSA employment amounting to 197,500. The 1983 labor force for the area was 2,390,200. The highest levels of employment are found in the sectors of services, trade, and manufacturing, in order of magnitude based on 1981 Department of Commerce data. Of the entire Gulf coastal zone, this is the fastest growing with an overall population growth over the 1978-1981 period of about 18%. Total and per capita personal incomes have increased by approximately 55% and 32%, respectively, over the same period. (For a complete listing of counties and a more detailed discussion of the Socioeconomic Environment, see Section III of the Final EIS for proposed sales 94/98/102 (USDI, MMS, 1984).

#### (2) Coastal Land Use and Water Services

From the western boundary east to Apalachicola, the coastal area is largely urbanized. Urban concentrations are from Pensacola to Panama City, particularly adjacent to recreational quality beaches. Development from Panama City to Apalachicola is less intense and residential land use predominates. East of Apalachicola to south of Crystal River, the coastal area is relatively undeveloped. Wetlands, forested areas, and limited agricultural and residential land uses are noted. South of Crystal River, urban development intensifies as commercial, residential, and industrial activities predominate. Urban centers include Tampa, St. Petersburg, Sarasota, Fort Myers, and Naples. The Tampa Bay Area is the most industrialized coastal area. South of Naples and Marco Island, the coast is mostly undeveloped. Large open spaces exist in the form of the Tenthousand Islands, the South Florida Fresh Water Preserve, and Everglades

National Park.

In general, the northwestern area of Florida is water rich, and sufficient supplies of groundwater exist in terms of quality and quantity for the foreseeable future. The Floridian aquifer is the principal source of potable groundwater in central and northern Florida and adjoining parts of Georgia and Alabama. It is the source of municipal water supply for such major urban centers as Tallahassee, Jacksonville, Gainesville, Orlando, Ocala, Daytona Beach, the Tampa-St. Petersburg area, and the Cape Kennedy area. In addition, the Floridan aquifer yields water to tens of thousands of domestic, industrial, and irrigation wells throughout the state. Thus, water in the Floridan aquifer is one of the most valuable natural resources in the state. However, the most serious environmental constraint to urban growth and economic development facing southwest Florida involves the availability of potable and nonpotable water sources. Rapid growth rates in urban population along the coastal areas of western Florida have caused severe shortages of potable water and considerable competition for once plentiful water sources. Those cumulative activities, which have led to the simultaneous lowering of both aquifer and water table levels, have resulted in sharply declining water tables and saltwater intrusion in many of the coastal area aquifer systems. The occurrence of saltwater in coastal freshwater aquifers is governed by the density contrast between the two waters, the elevation of the water table or piezometric surface in the freshwater aquifer, and the flow rate within the freshwater aquifer. Under natural conditions when the aquifer is relatively unaffected by pumpage, a net flow of freshwater to the sea will be present. In this case saltwater will occupy a wedge-shaped volume at the seaward end of the aquifer. Exploitation of the aquifer often results in a decline in the water table or piezometric surface with a resulting landward migration of the saltwater zone.

### (3) Commercial Fisheries

Based on NMFS landings data for 1972-1976 (Tidwell, 1983), approximately 349.2 million pounds of finfish and shellfish (excluding freshwater species) with a dockside value of $92.6 million are caught annually.

Important invertebrates landed at Florida's west coast ports include shrimp, spiny lobster, oyster, stone crab, and blue crab; however, shrimp is the most important fishery, consisting of white, pink, brown, and rock shrimp. In 1977, 33.1 million pounds of shrimp were harvested, worth about $40 million; spiny lobster landings were 4.9 million pounds, worth $7.9 million; oyster landings were 4.1 million pounds, worth $3 million; stony crab landings were 3.4 million pounds, worth $3.1 million; and blue crab landings were 15.9 million pounds, worth $3.1 million. Total landings of both finfish and shellfish in 1982 amounted to approximately 125 million pounds, worth $119 million. Some of the important fishes landed at Florida's west coast ports include snappers, groupers, mackerels, spotted seatrout, and black mullet.

There are approximately 8,576 commercial fishermen on the Florida west coast where processed fishery products amount to about $173 million. The main processed fishery products are shrimp, spiny lobsters, crabs, and oysters (USDC, NMFS, 1980).

### (4) Recreation and Tourism

The northern Gulf of Mexico coastal zone is one of the major recreational regions of the United States, particularly in connection with marine fishing and beach-related activities. The shorefronts along the Gulf coast of Florida offer a diversity of natural and developed landscapes and seascapes. The coastal beaches, barrier islands, estuarine bays and sounds, river deltas, and tidal marshes are extensively and intensively utilized for recreational activity by residents of Florida, the Gulf south and tourists from throughout the nation, as well as from foreign countries. Publicly-owned and administered areas such as national seashores, parks, beaches, and wildlife lands, as well as specially designated preservation areas such as historic and natural sites and landmarks, wilderness areas, wildlife sanctuaries, aquatic preserves, and scenic rivers attract visitors throughout the year. Commercial and private recreational facilities and establishments, such as resorts, marinas, amusement parks, and ornamental gardens, also serve as primary interest areas and support services for people who seek enjoyment from the recreational resources associated with the Eastern Gulf.

Three broad categories of recreational resources/activities are susceptible to direct and potentially significant impacts from OCS leasing and development: (a) offshore recreational fishing; (b) major shorefront recreational beaches; and (C) designated environmental preservation areas. For a detailed definition, description, and discussion of these resource categories and their relative importance within the planning area, see Volume 1, Section III.C.10. and Visuals No. 4, 10, and 14 of the latest Regional EIS (USDI, MMS, 1984).

Tourism has long been recognized as an important element of the Florida economy. According to the 1982 Florida Visitor Study, a record 39.3 million visitors traveled to Florida in that year, spending more than $21 billion at a variety of major attractions (Florida Division of Tourism, 1982). For the top 10 destinations of both auto and air visitors to the state of Florida, about 50% of the visitors traveled to counties within the area of concern for this analysis (which includes the entire Gulf coast of Florida). The major counties of destination in the study area in order of the number of air and auto visitors are: Dade, Pinellas, Okaloosa, Hillsborough, Escambia, Bay, Sarasota, Monroe and Manatee. About 50% of the Florida visitors in the 1982 survey cite the beaches as a primary interest. Other popular attractions in the study area include the Everglades, several state parks, sport fishing, and numerous activities in the larger metropolitan areas such as Miami, Tallahassee, and Tampa. Furthermore, in 1982, visitors to Florida generated 640,000 jobs with a payroll of about $4.4 billion and contributed about $989 million in tax revenues to the state. It seems reasonable to assume that about 50% of these jobs and revenues benefited the area of concern in this analysis.

### (5) Archaeological Resources

Based on information provided by the archaeological resources baseline study (CEI, 1977), supplemented by information from the quarterly Defense Mapping Agency printout of Nonsubmarine Contacts, MMS records show 42 confirmed shipwrecks. It should be emphasized that hundreds of other ships from all historic periods are known to have gone down, however, information on the location of these reported wrecks is not sufficient to allow mapping.

Relict barrier islands with back-barrier bays and lagoons, karst topography, and coastal dune lakes are all features which occur within the area, and which have a high potential for the occurrence of associated prehistoric sites. Preservation of site materials would be very good in karst areas and off the coast of central and southern Florida where wave energy is very low. Recovery of site information would be facilitated by the generally thin sequence of Holocene sediments.

### (6) Marine Vessel Traffic

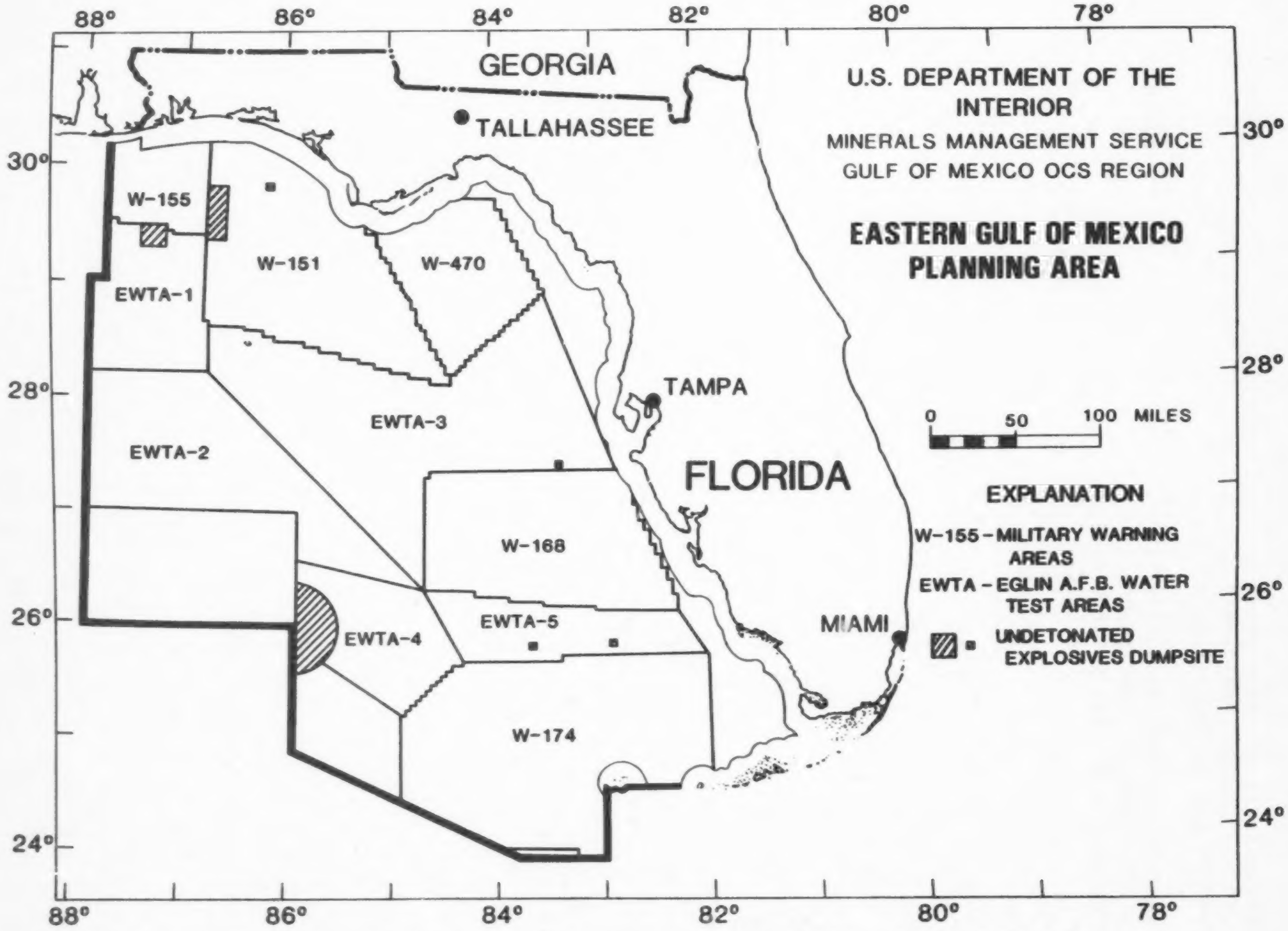
Marine vessel traffic visiting ports made up only about 5% of the total GOM Region traffic in 1981. However, this figure does not include the extensive amount of traffic that traveled through on its way to and from other GOM ports and the Atlantic Ocean.

The area contains United States Coast Guard (USCG) administered safety fairways that provide obstruction-free access to the Florida ports of Tampa/St. Petersburg, Port St. Joe, Panama City, and Pensacola. Many shallower draft vessels travel the Gulf Intracoastal Waterway (GIWW) which follows the coastline inshore and through bays and estuaries linking important ports from Fort Myers to the western boundary and beyond.

### (7) Military Uses

The area has five warning areas and a series of five water test areas used by the U.S. Navy and Air Force for missile testing and development, carrier maneuvers and carrier pilot training, pilot training, air-to-air gunnery, air-to-surface gunnery, air combat maneuvers, aerobatic training, and instrument training. The Navy, also, has an optics and sound testing area offshore Panama City, Florida. Space-use conflicts are developing between the USAF and Navy testing and training activities and oil and gas exploration and production. These areas are shown in Figure III.B.3.c.-1.

| Warning Areas | Defense Operations Conducted |
|---|---|
| W-155 | Air and surface gunnery and mine sweeping |
| W-151 | Surface and subsurface operations |
| W-174 | Air-to-air gunnery, air combat |



88°
86°
84°
82°
80°
78°
30°
28°
26°
24°
GEORGIA
TALLAHASSEE
U.S. DEPARTMENT OF THE INTERIOR
MINERALS MANAGEMENT SERVICE
GULF OF MEXICO OCS REGION
EASTERN GULF OF MEXICO PLANNING AREA
W-155
W-151
W-470
EWTA-1
EWTA-2
EWTA-3
TAMPA
FLORIDA
W-168
EWTA-5
EWTA-4
W-174
MIAMI
0
50
100 MILES
EXPLANATION
W-155 - MILITARY WARNING AREAS
EWTA - EGLIN A.F.B. WATER TEST AREAS
▨ ■ UNDETONATED EXPLOSIVES DUMPSITE

Figure III.B.3.c.1. Military Areas and Dumpsites in the Eastern Gulf of Mexico.

| | |
|---|---|
| | maneuvers, high altitude fighter radar intercept, aerobatic training, instrument training |
| W-470 | Air-to-air and air-to-surface operations, rocket firing, missile testing and research |
| W-168 | Air-to-air and air-to-surface operations, rocket firing, missile testing and research |

## C. Pacific Region

### 1. Washington and Oregon

#### a. Physical Environment

##### (1) Geology

Snavely, et al., (1977) provides a summary of geologic knowledge and possible geologic hazards in the Oregon and Washington Tertiary Province.

The continental shelf of Oregon and Washington, ranges in width from 8.8 miles (14 km) off Cape Blanco, Oregon, to 42 miles (68 km) at Hecata Bank, Oregon. The continental margin (shelf and slope) becomes progressively wider northward, ranging form 17.5 miles (28.2 km) on the southern Oregon OCS near Cape Blanco, to 90 miles (145 km) off the Hoh River of northern Washington. The continental slope off Oregon is steep and its base is generally straight and northwardtrending. In contrast, off Washington the base of slope is irregular, trends northwest and the inclination of the slope is gentle.

An important geomorphic feature of the continental slope north of latitude 44°30' is a series of north and northwest-trending ridges that commonly occur in water depths of more than 3,280 ft. (1,000 m). The internal structure of these ridges, as interpreted from seismic profiles, suggest that some are diapiric in origin. A broad terrace or bench 1,148-2,461 ft. (350-750 m) below sea level is an important feature off the central Oregon OCS between latitude 45°50' to 44°20'. It is generally widest where the shelf is narrowest (Snavely, et al 1977, and Byrne, 1963).

Several prominent banks occur on the Oregon OCS. The largest are Siltcoos, Hecata, Perpetua, Coquille, Nehalem and Stonewall. Pliocene, and less commonly upper Miocene, sedimentary rocks crop out on these Oregon submarine banks (Kulm and Fowler, 1974) and Quaternary sediments onlap their flanks. Seismic profiles indicate that most of the banks are complex structural highs.

Submarine banks are absent on the Washington OCS, but Swiftsure Bank lies just north of the international boundary between the U.S. and Canada. The Washington shelf is cut by several large submarine cayons, including the Willapa, Guide, Grays, Quinault, Juan de Fuca, and Nitinat canyons. Most of these canyons were cut by large rivers that dissected soft marine sediments during the late Pleistocene low stand of sea level. The only large submarine canyon on the Oregon shelf is Astoria Canyon the head of which is 10 miles (16 km) west of the mouth of the Columbia River. It extends nearly 60 miles (97 km) to a depth of about 6,000 ft. (1,829 m) where it joins the Astoria fan. This fan overlaps the continental slope extending from a depth of 6,000 ft. (1,829 m) along the slope to 9,000 ft. (2,743 m) at the abyssal plain (Byrne, 1962). The largest fan adjacent to the Washington slope is Nitinat fan whose source was on the southwest side of Vancouver Island, British Columbia.

The northern part of the Washington coastal region is characterized by numerous seastacks and small islands such as Ozette and Destruction islands. Similar features also are common along the southern Oregon coast.

### (2) Geologic Hazards

#### (a) Faulting and Warping

Numerous faults have been mapped in the coastal zone that offset upper Pleistocene deposits and in several places, as along the Olympic coast, faults offset recent soil zones up to 2 m. A high-resolution profile off Grays Harbor shows the seafloor sediments offset approximately 7 m by a "trap-door" type fault (Snavley, et al. 1977). Off Depoe Bay, Oregon, a north -trending zone of normal faults offset all but the most recent seafloor sediments. Although most of the recently recorded major earthquakes are concentrated in the Puget Sound area, there are historical accounts of apparent large earthquakes along the Washington coast. Based upon past experience, major earthquakes can be expected in the future on the continental shelf.

One potential non-seismic geologic hazard is warping of the seafloor above diapiric intrusions. Some 50 to 100 diapirs probably exist on the Washington and Oregon OCS. These siltstone piercement structures in many places warp, and less commonly, offset seafloor sediments. Also, the siltstone in these diapirs is probably overpressured and gas packets at shallow depths may be encountered during exploration drilling. Gas seeps are found along the flanks of several diapirs along coastal Washington and one just north of Taholah has produced a mud mound. Possible areas of unstable, poorly consolidated deposits may exist on offshore diapirs.

#### (b) Ground Failure

Water-saturated or highly sheared Tertiary sedimentary rocks (me'lange) and semiconsolidated Quaternary deposits which border much of the Oregon and Washington coasts are subject to ground failures (Snavley, et al. 1977). These rocks and deposits are highly susceptible to loss of bearing strength and slope failure either under the influence of gravity or ground shaking during earthquakes. The few highresolution profiles available on the OCS indicate that areas of moderate and relatively steep slopes contain numerous slump features. These are most prevalent in areas of thick sediment accumulation on steep slopes such as the continental shelf-slope break throughout the study area and on the flanks of several submarine canyons that incise into the shelf, such as the Juan de Fuca, Astoria, Quinault, Willapa, and the Eel River canyons.

#### (c) Submarine landslides

Landslides occur in several areas. These landslides may be the results of interbeds of volcanic ash that provide planes of weakness, thus facilitating mass transport. The ash undoubtedly has an important effect in reducing the bearing strength of the sediments on the OCS.

### (d) Tsunamis

Faults with apparent large vertical tectonic displacements are present on the OCS of the study area and may be capable of generating seismic seawaves.

Tsunamis, however, have not been reported following earthquakes whose epicenters lie on the OCS of Oregon and Washington. A tsunami wave generated by the March 1964 Gulf of Alaska earthquake struck Beverly Beach 6 miles north of Newport, Oregon.

### (3) Non-Petroleum Mineral Resources

Phillips (1979) reports that the continental shelf off Washington and Oregon contains limited areas with heavy mineral (opaque and non-opaque minerals that have a specific gravity greater than 2.96) in the surficial sediments. The heavy-mineral concentrations on the shelf are believed to have formed at lowstands of sea level during the Holocene transgression (Chambers, 1968, Clifton, 1968; and Bowman, 1972).

The heavy-mineral concentrations on the Oregon shelf with greater than 10 percent heavy-mineral content cover an area of 1,530 kilometers or 587 square miles. The total opaque-mineral content, calculated for only the areas of 10 percent or greater heavy minerals, would equal approximately 200,000 tons.

The heavy-mineral distribution on the Oregon shelf south of Tillamook Head shows eight areas containing greater than 10 percent heavy minerals. All deposits occur seaward or adjacent to river systems.

A heavy-mineral concentration containing up to 150 ppb gold ( Clifton, 1968), occurs off Cape Blanco. The gold bearing Sixes and Elk Rivers occur landward of the concentration. Heavy-mineral concentration at the shelf break adjacent to the Rogue submarine canyon contains the highest opaque value, 43 percent, for the shelf sediments. Surficial low grade gold concentrations are located off Cape Arago, south of the Coquille River, off Cape Blanco to Port Oxford, off Euchre Creek, and Gold Beach (Phillips, 1979, and Clifton, 1968).

The heavy mineral distribution on the Washington shelf is located in five areas: 1) south of Hoh River, 2) 2 deposits off Grays Harbor, 3) a concentration off Willapa Bay spit, and 4) seaward from the mouth of the Columbia River. The five heavy mineral concentrations on the Washington shelf with greater than 10 percent heavy minerals cover an area of 540 square kilometers or 206 square miles. The total opaque mineral content of areas of high heavy mineral concentration for the Washington shelf calculated to 1 meter depth, equals 80,000 tons (Phillips, 1979). The opaque content would be expected to increase with depth, but until three dimensional data is available for the marine concentrations the values would be speculative.

The largest concentration of heavy minerals on the Washington and Oregon shelf occur seaward from the mouth of the Columbia River. The highest heavy mineral concentration, greater than 30 percent (Byrne, 1966), occurs on the south side of the river mouth. Both concentrations extend from the shore out to depths of 100 m. The north deposit averages 6% opaque minerals (magnetite and ilmenite) (Phillips, 1979). The south deposit ranges from 6 to 15% opaques. The dredge spoils from the Columbia River are dumped to the south in the area of highest heavy mineral concentration. This suggests that wave and tidal currents may be reworking and removing the light sediment fraction leaving only a surficial heavy lag. The wide lateral extent and high mineral concentration occurring in this deposit makes it the largest along the Pacific coast.

Assay of 52 marine sediment samples collected in 1965 by the Bureau of Mines on the Washington shelf indicates minor gold values. Gold was detected in only 11 samples. The gold values ranged from 0.001 to 0.004 ounces per ton. Platinum was not detected. Spectrographic analyses indicated low values for most elements. Titanium, zirconium and chromium ranged in values form 0.1 to 1.0 percent.

(b) Polymetallic Sulfides: The Gorda Ridge has been identified as a center of slow sea-floor spreading located 160 and 330 kilometers of the coasts of Oregon and northern California. The Gorda Ridge trends in a NE-SW direction for approximately 350 kilometers. The Ridge is terminated in the south by the Mendocino Fracture Zone.

The Gorda Ridge can be subdivided into three distinct regions. The southern portion has a wide axial valley overlain by a thick sequence of sediment (turbidites) (McManus, 1967). The second region (central portion of the Region) is offset at 42°N. latitude, which may be attributed to an initial stage of development of a fracture zone (Mc Manus, 1967). The third region in the northern portion is a linear, fairly narrow axial valley with steep-sided walls.

The Blanco Fracture Zone is part of a large system known as the Juan de Fuca - Gorda Ridge System. The fracture zone angles west-northwest away from the continental slope off Cape Blanco, Oregon.

It has been interpreted that the Gorda Ridge is wither an active extension of the East Pacific Rise (Menard, 1966), a rejuvenated segment of an older ridge or rise system, or an auxillary ridge associated with the Mendocino Fracture Zone (Mc Manus, 1967).

In recent years theories on the tectonic setting of different kinds of ore deposits and the structural metallogenetic relations of selected key ore deposits have been developed. Hydrothermal proximal deposit Cyprus-type massive sulfides and "black smokers" have been associated with mid-oceanic ridges and ocean floor/oceanic crust formations.

The mid-ocean ridges mark the boundaries of tectonic plates and possible location of spreading centers. As the plates slowly separate underlying molten rock fill in the gaps. Sea water perculates through the cracks and fissures reacting with the molten rock. These fluids become superheated and take into solution available metals. The superheated fluid is ejected onto the seafloor through hydrothermal vents resulting in the precipitation of minerals from the solution. Mineral which can be found in Polymetallic Sulfide Areas are: zinc, copper, silver, lead, iron, sulfur, and silicon, with minor amounts of aluminum, selemum cobalt, magnesium, manganese, molybdenum, and barium.

### (4) Oceanography

#### (a) Chemical Oceanography

Chemical oceanography for the Washington and Oregon planning area has been described in the FEIS for Proposed Increase in oil and gas leasing in the OCS (USDI, 1975), DEIS for Proposed Polymetallic Sulfide Minerals Lease offering (USDI 1983), and Summary of Knowledge of the Oregon and Washington Coastal Zone and Offshore Areas (Oceanographic Institute of Washington, 1977).

The major nutrients required by phytoplankton, and typically discussed in chemical oceanographic sections are various forms of nitrogen [nitrate (NO3-), nitrite (NO2-), and ammonium (NH4+)]; phosphorus [Orthophosphate (H2PO4- and H PO42-)]; silicon [ortho silicic (S2O(OH)3-)]. Geographical distributions (to 45oN) are presented in the physical oceanography and meteorology of the California outer continental shelf (USDI, 1982).

Representative surface nutrient values for nearshore areas of Washington and Oregon, excluding the effects of upwelling, are 0.7 ug-atoms/l for phosphate, 5 ug-atoms/l for nitrate and 10 ug-atoms/l for silicate (Oregon State University, 1971).

Dissolved oxygen values for the Washington and Oregon area are in the range of 6.3 to 7.0 ml. per liter for surface water and salinity from 32.0 to 34.0 ppt. Nutrient levels vary depending upon proximity to local upwelling areas, rural runoff, and municipal sewage outfalls.

#### (b) Physical Oceanography

Hydrographic Conditions: The physical oceanographic conditions along the Washington and Oregon coasts are influenced by the northern limb of the North Pacific Gyre (the West Wind Drift) and a net input of fresh water into this region in the form of both precipitation and river runoff. The West Wind Drift originates in the Northwest Pacific and contains water transported from the tropics by the Kuroshio and from the Subarctic by the Oyashio (Dodimead, Favorite, and Hirano, 1963, pg. 18 and 111). Offshore of the Washington and Oregon Planning Area the West Wind Drift diverges into the northward flowing Alaska Current and the southward flowing California Current. In summer, part of the flow forming the California Current reaches the west coast of Vancouver Island before turning southward 1984). Discussions of the oceanography of the California Current System can be found in the Physical Oceanography and Meteorology of the California Outer Continental Shelf (DOI, 1982); Climatology and Oceanography of the California Shelf Region (CEAS, 1980); and the "California Current System-hypotheses and Facts," Hickey (1979).

Dodimead, et al.(1963) describes the area of the divergence of the West Wind Drift, off Washington and Oregon, as a region of overlap of the Transitional and Coastal Domains. They define the Transitional Domain as the region between colder, lower salinity Subarctic Water to the north, and the warmer, more saline Central Pacific Water to the south. In the Transitional Domain, water temperature in the upper layer is generally 7°C or greater in winter and 15°C or more in summer. Robinson (1976) shows a maximum monthly mean sea surface temperature of 15°C to 16.5°C occurring in late summer (August) and a minimum monthly average of 8°C to 10°C in late winter (February and March) in this area.

The Coastal Domain, according to Dodimead, et al. (1963) is characterized by marked localized variability in temperature and salinity. This variability is caused by local river runoff, upwelling, and mesoscale circulation features. The Columbia River provides a major source of freshwater to the Washington and Oregon Planning Area. The plume is advected with the large scale circulation.

Very near shore, tides influence the circulation and the distribution temperature and salinity through mixing. The boundary of the Coastal Domain is defined by Dodimead, et al. as the 32.4°/oo isohaline at 10 m depth.

Large Scale Circulation: Details of the circulation off the Washington and Oregon coasts have been described in numerous papers: Hickey (1979, 1981); Cutchin and Smith (1973); Huyer et al. (1975); Hsieh (1982), and Kundu and Allan (1976). Hickey (1979) provides an exhaustive description of the California current system and suggests that the large scale surface circulation beyond the shelf, out to about 250 km of the coast, is southward from May to August, northward between October and February, and variable the rest of the time. She also indicates that the currents within about 70 km of the coast are more variable than those farther offshore.

The structure of the current regime consists of California Current flowing southward at the surface, and the California Undercurrent which flows northward along the upper slope at depths of 200-300 m. A deep (200 m) surface mixed layer exists in this region during the winter primarily due to wind mixing. The depth of the mixed layer is substantially reduced during the "spring transition" which may be triggered by onset of upwelling favorable winds (Huyer et al. (1979).

Factors Influencing Circulation: The most significant forcing function of the coastal circulation along the Washington/Oregon coast and in the other planning areas is the wind stress. The local wind stress in this planning area is strongly from the south or southwest in winter (Nelson, 1977), resulting in wintertime downwelling along coast and offshore flow at depth. In spring it comes from the west and the north. The nearshore magnitude of the average wind stress is larger in winter than in other seasons (ibid).

Modes of Variability: As elsewhere along the U.S. West Coast, the temporal variability seen in oceanogaphic conditions along the northern California coast can be considered to be made up of a combination of: 1) seasonal variability i.e., conditions which tend to reoccur each year, although at somewhat differing times and intensities; 2) interannual variability, i.e., aperiodic events which reoccur over periods of several years, such as the El Nino conditions which were seen most recently in 1982 and 1983; 3) short-term events such as eddies and "squirts" or "jets," and "relaxation events."

Huyer and Smith (1985) describe the impact of the 1982-1983 El Nino on the oceanographic conditions of the Oregon coast as: anomalously high sea level, high coastal sea-surface temperature and increased poleward flow at about 70 m depth.

### (5) Water Quality

Waters off the coast of Washington and Oregon are relatively free of pollution. Water quality in the region is influenced primarily by two natural phenomena which include, 1) upwelling during the summer months that brings deep water to the surface, thereby lowering dissolved oxygen and increasing nutrients and carbon dioxide (CO2) concentrations in coastal waters, and 2) run-off from a number of rivers, the most significant being the Columbia River. The dilution effect of the Columbia River plume extends offshore of northern California during the summer and extends as far north as the Strait of Juan de Fuca during the winter. The overwhelming effect of the Columbia River plume on various water quality parameters is exemplified by studies which have tracked its salinity, alkalinity, productivity, turbiditty and radioactivity far into the sea. From 1944-1971, plutonium producing reactors at Hanford, Washington introduced radioactive waste into the Columbia River, which was subsequently traced in the water, sediments and biota (Oceanographic Institute of Washington 1977). The mean annual flow of the Columbia River is 7,200 m3/sec and ranges annually between 3,000 and 20,000 m3/sec. About 75% of the total discharge of rivers into the ocean from Oregon and Wahington comes from the Columbia River. The Columbia River carries some 6 million tons of suspended solids into the ocean each year (Proctor et al. 1980).

The fact that the Pacific Northwest Coastal Region is not densely populated is the main reason that most of the the region's estuaries are essentially unpolluted. Exceptions occur in the more populated and industrialized estuaries and those associated with shipping activities (Grays Harbor, Yaquina Bay, Coos Bay, Humboldt Bay and Columbia River). Localized degradation in water quality that is attributable to anthropogenic (man made) causes include logging activities, pulp mill wastes, domestic and industrial discharges, and agricultural runoff. Sea disposal of dredge material also occurs in the region.

Little information is available on background concentrations of pollutants such as trace metals and petroleum hydrocarbons in water, sediments and biota on the open coast of Washington and Oregon. Natural oil and gas seeps reportedly occur off the Olympic Peninsula of Washington, but no significant effects from the seeps have been described (Rau 1973, as cited by Oceanographic Institute of Washington 1977). Brown et al. (1979)

concluded that 23 sites located along shipping lanes in Puget Sound were relatively free of petroleum contamination.

### (6) Ocean Dumping

Ocean dumping regulations are discussed in detail in the FEIS for the Proposed Southern California Lease Offering, April, 1984.

Several sites in the Washington and Oregon planning areas have been used for dumping dredge materials, commercial and industrial wastes, explosives and toxic chemical munitions (see Table IV.B.7.a.(1)(b)-1 and Figure III.C.1.a.(6). A small quantity of Low level radioactive wastes (tools, gloves, transport containers, and other articles) was disposed of at three sites off Oregon. Explosives and toxic chemical munitions were dumped overboard from barges and ships or loaded on "liberty ships" and scuttled. Although, no sites are in the planning area there are two sites located north of the Washington border. Commercial and industrial waste usually consists of cannery waste and spent industrial chemicals. One site is located off Cape Flattery, Washington and another is in the Straits of Juan de Fuca.

Dredge spoil materials are being dumped off Washington and Oregon. Currently, there are 16 dredge disposal sites in the planning area. .wo of these are located in Washington and the others are off Oregon.

### (7) Climate

The climate of the Washington and Oregon coastal area is described as Mid-Latitude, Marine West Coast type with relatively mild winters and cool summers. Air masses moving through the region usually develop over the Pacific Ocean providing a moderating effect on the regional weather. The dominant pressure systems are the Aleution Low and the North Pacific High. The Aleutian Low dominates the winter weather along the Oregon and Wasington coast. Frontal storms develop in this region and move eastward across the Pacific Northwest bringing precipitation and cloudiness. Winter winds are generally from the west and southwest. During the summer months, the Aleutian Low contracts northward and is replaced by the expanding North Pacific High from the south. The Pacific High provides a buffer forcing Pacific storms northward above Washington state. This means that summers are generally times of fair weather with little precipitation. Winds are mostly northwesterly and somewhat lighter during the winter.

### (8) Air Quality

Air quality in the coastal regions of Oregon and Washington is generally good. Concentrations of particulates, nitrogen dioxide, ozone, sulfur dioxide, and carbon monoxide are within the national ambient air quality standards (See Table III.C.1.a.(8)-1). Emissions of air pollutants are generally widely scattered and do not significantly affect air quality.

## b. Biological Environment

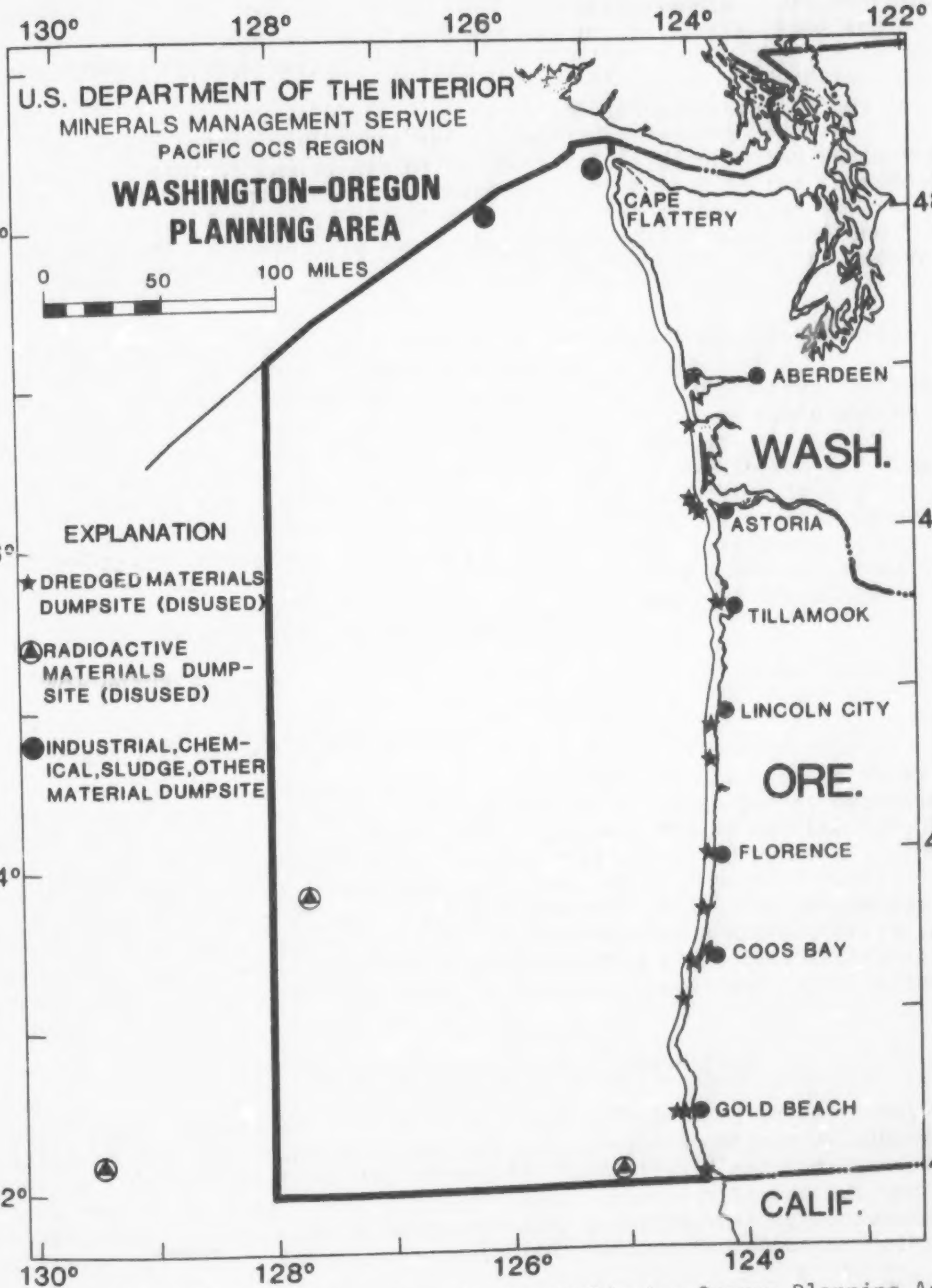

U.S. DEPARTMENT OF THE INTERIOR
MINERALS MANAGEMENT SERVICE
PACIFIC OCS REGION
WASHINGTON–OREGON PLANNING AREA
0
50
100 MILES
130°
128°
126°
124°
122°
48°
46°
44°
42°
CAPE FLATTERY
ABERDEEN
WASH.
ASTORIA
TILLAMOOK
LINCOLN CITY
ORE.
FLORENCE
COOS BAY
GOLD BEACH
CALIF.
EXPLANATION
★ DREDGED MATERIALS DUMPSITE (DISUSED)
Ⓐ RADIOACTIVE MATERIALS DUMPSITE (DISUSED)
● INDUSTRIAL, CHEMICAL, SLUDGE, OTHER MATERIAL DUMPSITE

Figure III.C.1.a.(6). Dumpsites in the Washington-Oregon Planning Area.

### (1) Plankton

Phytoplankton and Zooplankton are discussed in detail for California and Oregon and Washington in the Sale No. 48 Final Environmental Statement and the Summary of Knowledge of the Oregon and Washington Coastal Zone and Offshore Areas, respectively.

The most significant characteristic of Pacific Coast plankton ecology is upwelling, which occurs during the spring (April or May) in Southern California an later in the summer on the rest of the coast. The subsurface water is cold (10°C) and rich in the nutrients which rise to the surface of the coastal waters during periods of upwelling. The combination of abundant nutrients and adequate sunlight allows prolific phytoplankton growth (up to several million cells per liter during blooms) in the upper 50 meters of water.

Zooplankton abundance is closely related to the biomass of phytoplankton, as the latter serves as the primary food source for zooplankton. Therefore, zooplankton abundances follow phytoplankton abundances, although with a characteristic lag of several weeks, representing an exploitation and utilzation phase of the plants by zooplankton. Phytoplankton and zooplankton distribution and ecology off the coast of Washington and Oregon are influenced by two physical phenomena: nutrient upwelling in the nearshore areas and nutrient-laden freshwater entering the coastal water rivers and coatal estuaries. In comparison to coastal California, especially Southern California, the influence from rivers and estuaries is much stonger off Washington and Oregon. the most important freshwater source in the planning area is the Columbia River.

### (2) Benthos

#### (a) Intertidal Benthos

Rocky shores and sandy beaches are the two predominant beach types along the Washington and Oregon coast. The percentage of rocky shores decreases from south to north in the planning area. Southern Oregon has the largest percentage of rocky shores in this planning area (30 to 40 percent). The remainder of coastal Oregon and Washington have only 10 percent rocky shores during most of the year. During the winter months the percentage of rocky shore increases somewhat as small pocket beaches are transformed into rocky areas. Two predominantly rocky areas of note along this section of the coast are: Otter Rock area north of Newport, Oregon and Cape Flattery, Washington.

##### (i) Rocky Shore Intertidal Communities

Although rocky intertidal areas are very rich in plant and animal life, the inhabitants must withstand environmental pressures not endured by subtidal organisms. Because of this, the intertidal community is exposed to air for various amounts of time. This exposure causes organisms to dry out and eventually die, unless certian morphological, physiological or behavioral adaptations are made. Behavioral adaptations include hiding under rocks, large algae and invertebrates, or becoming part of a subassemblage association such as a mussel bed.

These physical environmental and biological pressures then help determine the character of rocky intertidal areas. Zonation is one of the key features of the rocky intertidal areas. According to Stephenson and Stephenson (1949, 1972) the zonal patterns for the Washington and Oregon planning area are as follows:

> Above the high-water level exists an arid zone, transitional between land and ocean. Ocean spray regularly reaches this zone and marine waters contact it directly only during the highest spring tides and during storms when onshore winds and heavy surf drive water far above the intertidal zones. Relatively few species occupy this they include snails adapted to arid conditions belonging to the genus Littorina.
>
> Rock surfaces of the arid zone, or in its lower part, are commonly blackened by encrusting lichens of the Verrucaria type. This black zone may form a continous belt or be discontinous or it may overlay into the zone below, but it is usually a persistent feature.
>
> The middle part of the shore is that which is covered and uncovered by each day's tides. This zone supports a greater variety and number of organisms than does the drier zone above it. It typically supports balanoid (acorn) barnacles of the genera Chthamalus and Balanus. This zone may be further divided into subzones in response to a gradient of adaptive pressures that ranges from adverse physical conditions intense predation and space competition pressures from just below this zone.
>
> The lowest part of the shore, which is uncovered by spring tides, supports a fringe of the infralittoral populations that are present in the region below tidemarks that is never uncovered. These populations are variable but extremely rich, and in the old-temperate waters of Oregon, Washington and British Columbia consist of large brown algaes (e.g., laminarians) that cover an undergrowth of small algae and a variety of fauna.
>
> Also in this wet zone, nonjointed calcareous red algae of the family Corallinaceae ("lithothamnia") encrust all available surfaces. This encrustation extends below tide marks as well as into the region above the wet zone and may extend even higher into the intertidal zone where wet crevices and tidepools can support these algae.

In summary, three principal zones may be said to persist on rocky shores in the Washington-Oregon study area: "a Littorina zone above, a barnacle zone in the middle, and a wetter zone of variable population below" (Stephenson and Stephenson, 1972).

### (ii) Sandy Beach Intertidal

Exposed sandy beaches predominate the Washington and Oregon coastal area. The sandy intertidal region is much less stable then the rocky shores region due to the continental shifting of sand by wave action. Organism on sandy beach areas have solved the problem of wave shock by burying themselves in the sand or by moving up and down the beach as the tidal level fluctuates.

The only flora to be found in this type of environment includes diatoms and other microscopic species and bacteria associated with organic detritus in the sand.

Microscopic plants, bacteria and detritus constitute the food base for a host of tiny animals that inhabit the interstitial spaces between sand grains. These consist primarily of small copepods, nematodes, ostracod and gastrotrichs. There are few, if any, specific accounts of this interstitial (or meio-) fauna for the sandy beaches of the Oregon-Washington-British Columbia coastal region, but overview discussions of the nature and occurrence of meiofauna do exist (Swedmark, 1964; McIntyre, 1969, and Hulings and Gray, 1971). In some temperatezone beaches this interstitial life is well developed and seems to be especially rich in more sheltered beaches composed of larger grains or mixed sands (especially small pocket beaches), but is better developed in the intertidal zone. On the open beach, it is seasonal in character and attains its maximum development during the summer months. It has been suggested (Faure'-Fremiet, 1951) that the organic films and slimes produced by bacteria, protozoa, worms, etc., stabilize the sand to a certain degree and therefore are an important factor in this environment.

### (b) Sub-tidal Benthos

Collectively, the benthic biota make up one of the most complex and lease understood areas of marine biology. The complexity arises form the many diverse adaptions of these animals to their environment. These adaptions include burrowers, scavengers, suspension-feeders, predators, and parasites. Benthic biota are also of economic importance, shrimp, lobster, and halibut, for example, are valuable fisheries.

Benthic assemblages along the Pacific coast are primarily distributed according to water temperature, water depth, and type of substrate (sea bottom). Other factors influencing the benthos are distance from shore, currents, food availability and water quality. Epifaunal communities reach their maximum development in the intertidal zone, while the infauna dominates the sea floor beyond the subtidal zone (Odum, 1971).

The primary food source of shallow water benthic organisms includes living plants and animals, whereas deep-water benthic animals depend on the continual rain of dead organisms and detritus from above. This material is ingested by the primary consumers such as worms and molluscs. Other benthic organisms feed on the organic material they encounter while burrowing in the sediments. The benthic community is therefore related to the surface water productivity. Surface waters of the U.S. Pacific coast are highly productive because of the upwelling process. Correspondingly, a rich benthic community exists in this area.

According to Karshman, Johnson and Eby (1977), the benthic fauna off the Washington and Oregon coast are comparable. Certain assemblages recognized as infauna off Washington probably apply to Oregon as well. Some major changes in dominant taxa may be observed with depth along the shelf and slope off Oregon and these probably also apply to Washington. Standing crops off Oregon appear slighly higher, and it may be expected that some differences do exist in species present or in productivity of overlying water.

The composition of benthic fauna of the central Oregon continental shelf changes with increasing depth and distance from shore (Carey, 1972). The epifauna changes from a sparse molluscan assemblage to one dominated by numerous echinoderms and arthropds. The infauna demonstrate a seaward variation in species composition; arthropods are dominant close to shore; and polychaetes are dominant offshore. Abundance increases seaward; the largest numbers and greatest biomass of both epifauna and infauna were found at the outer edge of the continental shelf.

Lie (1969) and Lie and Kisker (1970) reported three communities which were distributed according to sediment type, depth, and distance from the Washington shore. The standing crop at the shallow water stations having fine sand substates was dominated by crustaceans and small lamellibranchs (clams), whereas the deeper stations with silt-clay substrate were dominated by polychaetes and echinoderms.

### (3) Fish

The Washington and Oregon offshore marine environment supports about 400 fish species including both year-round residents and seasonal migrants (Schultz 1936, Miller and Lea 1972, and Hart 1973). More species tend to be found in the warmer waters to the south, but some are found only in the area's northern reaches. Most species inhabit the entire length of the area.

The continental shelf is relatively broad and even of width through this planning area, narrowing to the south. There are two major submarine canyons, one off of the Strait of Juan de Fuca and the other off the mouth of the Columbia River, as well as many small sea floor canyons. Major banks and basins occur, but are not a major feature. The most prominent banks are Stonewall, Hecata, and Perpetua off of central Oregon.

Fish concentrations are usually associated with habitat gradients. A characteristic gradient of western continental slopes is upwelling. This is the phenomenon of deep, cooler, nutrient laden waters rising to the surface. The nutrients enrich the local food web base, and a bigger web of greater numbers and species is built on top. Similar situations exist near non-toxic sewage outfalls that are not so rich as to make the water anaerobic and kill oxygen dependent life forms. Other important gradients are current boundaries, temperature and salinity (and hence density) changes including freshwater inflows, and the topographic relief of the bottom.

Marine fish habitats can be divided into pelagic, benthic, and deepsea. Benthic can be further divided into offshore and shallow, and shallow can be further divided into rocky bottom and sandy bottom types. The deep sea zone will not be discussed here as it is outside of feasible drilling areas and its inhabitants only rarely wander into areas proposed for leasing.

The pelagic, or epipelagic, zone consists of oceanic and neritic waters to a depth of 200 meters, or about 650 feet (the mesopelagic, bathypelagic, and abyssopelagic zones are considered part of the deep sea). The benthic zones includes the ocean floor and closely associated waters. It also includes waters associated with kelp beds and natural and man-made vertical relief.

The epipelagic zone contains many fish which migrate over vast areas, including albacore tuna and the Pacific salmons. Other fish such as herrings, mackerels, and sardines migrate over smaller areas. Few, if any, pelagic fish don't migrate to some degree for feeding or reproduction. The opalescent, or market, squid (Loligo opalescens), though a mollusc, is an actively swimming member of the pelagic nekton.

Because there is little physical cover in the pelagic zone, residents are streamlined (fusiform) for speed and efficient prolonged swimming (Marshall, 1971). They are also camoflaged, being countershaded dark above and light below (Marshall, 1966). Fishes which are more adapted to the benthic zone are frequently found in the epipelagic zone, but usually not far from their preferred habitat. Deep sea fishes frequently migrate up into the epipelagic zone at night, presumably to feed (Marshall, 1971). Additionally, the early lifehistory stages (eggs and larvae) of many marine fishes are planktonic in the epipelagic zone.

The assemblages of fishes found in association with benthic habitats are as varied as the habitats themselves. These include (for the porpose of this discussion) offshore, rocky shallow, sandy shallow, and vertical relief. Some species are confirmed to one habitat type, but most may be found in several types, though favoring one.

The offshore benthic region includes those areas that are out of the major direct impacts of tidal, wave, beach, and shoreline processes. It includes the bottom beneath the epipelagic zone. It is usually sandy or muddy, but rocky outcroppings do occur. Many species common to this zone are very important commercially (see Commercial Fisheries). These include flatfishes, lingcod, some rockfishes, cods, and sablefish. Many of these fishes, especially hake (cod family) are also common in the lower epipelagic zone.

The shallow, rocky bottom benthic environment includes tidepools and subsurface lithic outcrops not covered by sand or other fine sediments. It commonly includes many surface irregularities which may serve as a shelter or food concentrator. Significant vertical relief is a major ecological trait of this zone. The variety of niches that rocky areas provide is a factor in the relatively large number of species that live in this habitat type. Rockfish, lingcod, sculpins, blennies, and eels are typical residents.

The shallow, sandy bottom benthic environment is that area within the region affected by wave, tide, and shoreline processes that has a fine grained, mostly planar surface. Common residents include skates and rays, sturgeons, smelts, surfperches, and flatfishes. The sandy zone is always changing and moving whereas the rocky habitat is more rigid and lasting.

Vertical-relief benthic areas, including kelp beds and man-made structures are reef-like, reference surfaces and gradients being oriented more vertically than horizontally. The habitat may reach from the sea floor to the sea surface, from the aphotic zone to the air-water interface (pleuston). Fishes of both pelagic and benthic habitats are found in association with these areas, as well as more specially adapted species like kelp bass. Species common to other habitats may occur here much more densely. The areal extent of these areas may be very small, but their productivity is relatively quite high.

Estuaries, such as Puget Sound and adjacent waters, Gray's Harbor, Willapa Bay, the mouth of the Columbia River, and many smaller bays, lagoons, and river mouths along the Washington and Oregon coast provide other fish habitats. These habitats vary with the physical characteristics of the estuary. Large fjords (Puget Sound), large bays (Gray's Harbor), small bays (Coos Bay), big river mouths (Columbia River), and small river mouths (Siuslaw River) are all different from one another. Shallow water benthic species are common, and deeper water benthics may be found in deep fjords. Freshwater species may be found in the less saline surface layers. Migratory species may be found during the proper season. Species composition may change with tides, daylight, or seasons. Because of high nutrient loads (see Estuaries section), these habitats are diverse and very productive. See Table III.C.1.b.(3) for a list of representative fishes and their habitats for Washington and Oregon.

### (4) Marine Mammals

Marine mammals reported in the Washington and Oregon offshore area either as seasonal migrants, or year-round or seasonal residents may include as many as 33 species. Of the 33 species, 27 are cetaceans (whales, porpoises, or dolphins), 5 are pinnepeds (seals or sea lions), and 1 is a carnivore (sea otters). The species include: Northern right whale, minke whale, sei whale, fin whale, blue whale, humpback whale, gray whale, beaked whales, sperm whale, common dolphin, northern right whale dolphin, Pacific striped dolphin, Risso's dolphin, Killer Whale, shortfinned pilot whale, Harbor porpoise, Dall porpoise, Sea otter, northern elephant seal, harbor seal, northern or steller sea lion, northern fur seal, California sea lion. Seven whales are listed as endanged by the U.S. National Marine Fisheries Service. A detailed discussion of habitat, range, feeding/ swimming behavior characteristics, and food source can be found in the Summary of Knowledge of the Oregon and Washington Coastal Zone and Offshore Areas, August 1977, Vol. II, Chapter IV and the Draft EIS for the Proposed Polymetallic Sulfide Minerals Lease Offering, December, 1983.

### (5) Coastal and Marine Birds

Table III.C.1.b.(3)-1

## REPRESENTATIVE FISHES AND THEIR HABITATS, WASHINGTON AND OREGON

| Species | Habitat | | | |
|---|---|---|---|---|
| | Epipelagic | Benthic | | |
| | | Shallow | | Offshore |
| | | Sandy | Rocky | |
| Pacific lamprey | X | | | |
| Salmon shark | X | | | |
| Bigskate | | X | | |
| White sturgeon | | X | | |
| Pacific herring | X | | | |
| Pacific sardine | X | | | |
| Pacific salmons (5 spp) | X | | | |
| Steelhead trout | X | | | |
| Surfsmelt | | X | | |
| Eulachon | | X | | |
| Night smelt | | X | | |
| Northern clingfish | | | X | |
| Pacific hake | | | | X |
| Pacific cod | | | | X |
| Walleye pollock | | | | X |
| Pacific saury | X | | | |
| Rockfishes (sev spp) | | | X | X |
| Sablefish | | | | X |
| Lingcod | | | | X |
| Sculpins (sev spp) | | | X | |
| Jack mackerel | X | | | |
| Surfperches (sev spp) | | X | | |
| Pacific sandlance | | | | |
| Pacific mackerel | X | | | |
| Albacore tuna | X | | | |
| Pacific butterfish | | X | | X |
| Pacific halibut | | X | | X |
| Rock sole | | X | | X |
| Curlfin turbot (sole) | | X | | X |
| English sole | | X | | X |
| Butter sole | | X | | X |
| Starry flounder | | X | | X |
| Rex sole | | X | | X |
| Dover sole | | X | | X |
| Petrale sole | | X | | X |

READEX FICHE

The Washington and Oregon coastal zone and offshore area host a large and varied population of marine associated birds and waterfowl. This is due in large part to the abundant marine food supply available and the availability of extensive areas of ideal habitat. As one proceeds north from Southern California areas available as bird habitat increases (e.g., offshore rocks, inlets, islands, large undeveloped areas and inaccessible areas). The most common species found along Washington and Oregon are: Leach,s petral, rhinocerous auklet, tufted puffin, fork tailed petral, common murre, glaucous-winged gull, western gull, Brandt's cormorant, pelagic cormorant, Cassin's auklet, black oyster catcher, pigeon guillemot, double crested cormorant, and hybrid glaucous-winged western gull. Leach's petral is the most abundant in this area with an estimated breeding population exceeding 500,000 off the Oregon coast.

The largest single migrant species are the shearwaters, which pass along this section on the coast on their seasonal migration from Alaska to the southern hemisphere. This area is also part of the Pacific flyway for waterfowl (duck, geese, and swans) in the United States. Detailed discussions of species, locations, abundance and times of occurence can be found in the DEIS for the Proposed Polymetallic Sulfide Minerals Lease Offering, December, 1983, and the Summary of Knowledge of the Oregon and Washington Coastal Zone and Offshore Areas, August, 1977.

### (6) Endangered and threatened species

The Washington and Oregon planning area contains several State and Federally listed threatened and endangered marine and terrestrial species that may be affected by proposed offshore lease sales. Offshore species most commonly listed that might occur in the Washington and Oregon area include the gray whale, humpback whale, sperm whale, blue whale, fin whale, right whale, sei whale, Southern sea otter, Leatherback sea turtle and Green sea turtle, and the brown pelican.

Terrestrial species include: Bald eagle, American perigrine falcon, Aleutian Canada goose. Detailed discusison of species, status, habitat, estimated population size, range, etc., can be found in the Summary of Knowledge of the Oregon and Washington Coastal Zone and Offshore Areas, Vol. II, August, 1977 and DEIS for Proposed Polymetallic Sulfide Minerals Lease Offering, December, 1983.

### (7) Estuaries and Wetlands

In contrast to California, estuaries in the Washington and Oregon planning area are considerably larger and consequently more important to the coastal marine environment. California estuaries and wetlands average only about 400,000 acres, while the Washington and Oregon areas contain well over 1 million acres. Important estuaries include: Columbia River estuary (15,000 acres), Coos Bay (9,500 acres), Tillamook Bay (8,800 acres), Umpqua-Winchester Bay (5,700 acres), Willapu Bay (34,800 acres), Grays Harbor (7,100 acres), and Puget Sound (approximately 1.3 million acres). Wetlands and estuaries are extemely important as nursery areas and as a nutrient source for several important fisheries which include salmon, crabs, clams, oysters, shrimp and a few fin fish. For a detailed discussion of estuaries and wetlands, see the Summary of Knowlege of the Oregon and Washington Coatal Zone and Offshore Areas, August 1977, FEIS for Proposed Increase in Oil and Gas Leasing on the Outer Continental Shelf, 1975 and DEIS for Proposed Polymetallic Sulfide Minerals Lease Offering, December, 1983.

### (8) Areas of Special Concern

There are no officially designated ecological reserves, marine life refuges, or area(s) of special biological significance (ASBS) in the Washington and Oregon planning areas. However, sensitive species and important habitat in the Washington and Oregon planning area are discussed under the appropriate subheading.

### (9) Marine Sanctuary

The objectives of the marine sanctuaries are to preserve a unique and strategically located ecosystem (intertidal, subtidal, benthos, pinnipeds, seabirds, recreation and cultural resources), to encourage scientific research and to enhance public awareness of the sanctuary resources.

At the present time the Washington and Oregon planning area does not have any officially designated marine sanctuaries. However, the National Oceanic and Atmospheric Administration (NOAA) has identified the Heceta-Stonewall Bank as having characteristics that qualify it for designation as a Natural Marine Sanctuary (48 FR 35568 August 4, 1983). The area is approximately 1,000 km2 in size located off central Oregon in water depths of 200 meters or less. This is a hard bottom bank with relatively high productivity supporting commercial quantities of rockfish, hake, lingcod, ocean perch, flounder, sole, halibut, salmon and sablefish.

## c. Socioeconomic Environment

### (1) Employment and Demographic Conditions

The Washington and Oregon planning area includes the coastal counties of Whatcom, Skagit, Snohomish, King, Pierce, Thurston, Mason, Kitsap, Jefferson, Clallam, Island, San Juan, Grays Harbor, Pacific and Wahkiakum, (Washington) and Clatsop, Tillamook, Lincoln, Lane, Douglas, Coos and Curry (Oregon).

Development along the Pacific northwest coast has been limited to a relatively narrow strip of land between the coast and the pacific coast range. Unlike Southern California, there are no densely populated areas along the coast. The steep cliffs and bluffs resulted in major development remaining further inland, therefore, the pacific coast of Washington and Oregon primarily consists of large undeveloped areas interrupted by occasional small communities located near streams and rivers. This is best demonstrated by the study areas population distribution in which four counties (King, Pierce, Snohomish, and Lane) account for 71 percent of the study areas population.

Historically, the Washington and Oregon planning area has been a resource oriented economy depending primarily on agriculture, forestry and fishing. During the period 1970-80 both Washington and Oregon moved steadily toward a more diversified economic base which included manufacturing, food processing, forest products, and smeltering. However, forestry and commercial fishing are still the primary economics in the pacific northwest. Recreation and tourism is also an important segment of the coastal economy as public recreation facilities dot the entire coastline.

### (2) Coastal Land Uses and Water Services

The land use discussion for the Washington and Oregon planning area is generally restricted to the area from the coast inland to the coast range. A large portion of land use categories, as previously discussed in Section III.C.3.c.(1), in the Washington and Oregon coastal zone are either classified as undeveloped or designated recreational use. Major urban areas are inland in the Puget Sound area (Seattle, Tacoma and Everett) and the Willamette Valley (Portland and Eugene). Both of these areas are characterized as having urbanized with large central cities. Coastal areas are predominantly rural with small towns specializing in agriculture, fisheries, forest activities and recreation. Approximately one-half of the coastal area is in some form of public ownership. The Federal government is the primary administrator of public land in this area through the Department of Agriculture (U.S. Forest Service) and the Department of the Interior (National Park Service, Bureau of Land Management and the Bureau of Indian Affairs). The proposed planning area has an abundant supply of fresh surface water. The Columbia River is the major stream system draining the Washington and Oregon area. Other major coastal rivers include the Chihalis, Quinault, and Soleduck along the Washington coast and the Rogue and Umpaqua on the Oregon coast.

Major consumption uses of water in the area are for municipal, industrial, rural-domestic,and to a lesser extent for irrigation purposes. Industrial use accounts for over 50 percent primarily to the pulp and paper and lumber industry scattered along the coast.

Muncipal use is the second largest consumption source followed by rural-domestic and irrigation consuming less than 20% of the total.

### (3) Commercial Fisheries

Washington and Oregon are major commercial fishing states with a long and colorful history of harvesting food from the sea. With the recent depression of the timber industry, especially in coastal areas, the importance of commercial fishing and ancillary activities to the local economies of the region has increased dramatically.

In 1983 over $38 million worth of fish and shellfish were landed at Oregon ports (Lukas and Carter, 1985). Applying a multiplier factor of 3.1 (U.S. Water Resources Council, 1977) to include related activities (processing, transportation, marketing, etc.) results in a total value of $118 million for the Oregon fishery. Similar values for the 1983 Washington fishery were $68.4 million (Washington Department of Fisheries, 1984) and $212 million. So the total economic value of the planning areas commercial fisheries in 1983 was $330 million. Almost all of this amount is earned and spent by people living in the coastal region, making the fisheries especially valuable to these locales.

Major ports are located around the Puget Sound, Grays Harbor, and Willapa Bay areas of Washington and Astoria, Newport and Coos Bay, Oregon. Numerous smaller ports are located along the coast throughout the area.

The most important fisheries in the region are those for the five Pacific salmon: sockeye (red), pink (humpback), chum (dog or keta), coho (silver), and chinook (king or tyee). Chinook are the most important salmon, dollar-wise, but at certain times and locales any species may dominate. Important fisheries also exist for albacore tuna, sablefish (blackcod), Pacific hake (whiting), rockfishes, Pacific cod, Pacific halibut, rex and petrale sole, other flatfishes, Pacific herring, shrimps, snow (Tanner), king, and dungeness crabs, oysters, scallops, and clams.

Trawling is the most predominant fishing technique, used for most of the fin fish species and free swimming invertebrates (shrimp, squid). Seining, trolling, and long-lining techniques are also used. Pots and traps are used for (benthic) crustaceans, while rakes, "guns", dredging, and hand labor are used for benthic molluscs.

Mariculture is providing commercial returns of salmon, oysters, and scallops, and is involved in research and development experiments with other fishes, molluscs, and crustaceans. Most activity occurs around Puget Sound, the Columbia River, and major bays and estuaries.

The Columbia River is the largest river emptying into the eastern Pacific Ocean. It also contains the spawning and nursery grounds for the largest source of salmon to the Washington and Oregon fisheries. Fifty years of development, dam building, diversion, and overfishing have seriously depleted its once bountiful supplies. Catches by commercial fishermen have seriously suffered accordingly. Numerous hatcheries have been built to try to replenish the runs, and although they have helped somewhat to alleviate the situation they have not fully restored the runs to historical levels.

Competition for salmon in the Pacific Northwest is extremely keen between commercial fishermen, sport fishermen, and native fishermen. The allocation of salmon between user groups, states, and the U.S. and Canada is an item of contention. The Boldt decision allocated salmon between native and non-native fisheries, the Pacific Fishery Management Council establishes catch limitations for non-native American fisheries, and treaties between the U.S. and Canada allocate the fishes of comingled oceanic stocks. Pacific halibut are also managed by a treaty-authorized commission.

More detailed discussions of the fisheries can be found in Glude (1971), Browning (1980) and Miles, et al (1982).

### (4) Recreation and Tourism

The coastal area of Washington and Oregon offers many unique and diversed recreational opportunities for both resident and tourist alike. The WashingtonOregon combined coastlines stretch approximately 600 miles. Recreation activity is primarily water oriented along the coast. Recreational activities in the coastal areas include boating, fishing, camping, sightseeing, clam digging, beachcombing, picnicing, hiking, diving and swimming.

Recreational boating is an especially important activity for both Oregon and Washington. It is estimated by the State of Oregon that approximately one-fourth of its 2.7 million people enjoy some sort of boating activity. Approximately 10 pecent of the users are from out of state. A pleasure boat study conducted by the Corps. of Engineers for Washington State Parks and Recreation Commission included that pleasure boat ownership was well above the national average.

Detailed information on recreation use and ownership can be found in the Summary of Knowledge of the Oregon and Washington Coastal Zone and Offhsore Areas, 1977.

### (5) Cultural Resources

The Oregon and Washington coastal area contains numerous prehistoric and historic archaeological sites. Many of these sites represent native American resources, with the coastal areas of both states having extremely high potential for investigation because these areas were home to the early coastal indian tribes. It has been estimated that over 1,000 sites exist on the north Oregon Pacific coast, and that less than one-fifth of these sites have been inventoried. The locations and descriptions of most of these sites is restricted because of the potential for vandalism and looting of the sites. Onshore Historic sites in both states are numerous and are listed in such inventories as the National Register of Historic Places, and the State Register of Historic Places.

Offshore sites (submerged resources) can include several catagories of resources such as aboriginal remains, and sunken ships and aircraft. At present there are no known and recorded submerged aboriginal sites in federal waters off Oregon and Washington. Numerous shipwrecks have occured in the region, with most occuring close to shore at harbor, bay or river mouths. Locations of shipwrecks in the past has not been extremely accurate, due to the normally violent circumstances underwhich they occurred, due to the state of the art in navigation the time of the loss, due to loss report error, and due to vessel drift.

The field of marine archaeology in this region, as is the situation in most areas, is still in its infancy. Therefore, submerged resources in this area have not been examined or inventoried in sufficient detail to be able to give an accurate or detailed description.

### (6) Marine Vessel Traffic

There are currently no established or proposed vessel traffic lanes along the Washington and Oregon coasts. There is, however, a Puget Sound Vessel Traffic Service Area (PSVTS), including a traffic separation scheme (TSS). The TSS comprises a network of one-way traffic lanes, separation zones between lanes, and precautionary areas where vessels cross, join, or leave the TSS. See Table III.C.1.c.(6)-1 for data on port activity.

### (7) Military Uses

Military land use along the coast of Washington and Oregon is relatively insignificant for most of Oregon and part of Washington. (See Figure III.C.1.a(6)). Many of the shore facilities are either not active most of the year or are used for other purposes such as recreation or wildlife conservation. Primary military activity occurs at the extreme ends of the planning area (Puget Sound to the north and San Francisco Bay area to the South) and may pose potential conflicts with leasing activities. Although the Oregon and Washington offshore area does not have the degree of military activities present in the Southern California area. However, the Navy does carry out certain activities in the North Pacific that could be impacted by OCS activities. Portions of the planning area are used by the Navy for submarine transit lanes running north-south. In addition, other military activities necessary for National defense and security may take place as the need arises. As discussed in the Ocean Dumping section the Navy is considering the disposal of spent nuclear submarines on the ocean floor south of the planning area in offshore northern California.

### (8) Native Subsistence

Coastal Oregon and Wahington subsistence gathering, although not well documented, may involve several thousand individuals. Subsistance gathering involves both indian and other various ethnic groups following traditional intertidal food gathering practices in their ethnic background whether it is for religion or economic purposes.

Subsistence gathering along the Washington and Oregon coast involves not only foodstuff but traditional medicines, herbs and teas as well. However, the taking of salmon and shellfish make up the largest portion of the subsistence economy for Washington and Oregon. The subsistence economy for Washington and Oregon is more than just direct use of the resource by the individual or group. Ocean resources are also used in an extensive barter system exchanging salmon etc. for inland resources (deer and elk, etc.). The resources are also sold for cash as a means of supplementing their income.

Table III.C.1.c.(6)-1

Marine Vessel Traffic - Major Ports of Oregon and Washington

Source: U.S. Department of the Army, Corps of Engineers. Waterborne Commerce of the United States, Calendar Year 1982, Part. 4. July 1984.

| Port | Total Number of Vessel Trips (Includes self and non-self propelled, excludes domestic fishing craft) | | Total Freight Traffic (Short Tons) |
|---|---|---|---|
| | Inbound | Outbound | |
| Columbia River Basin Total Waterborne Commerce (OR, WA, ID) | 48,260 | 48,256 | 44,431,260 (adjusted) |
| Portland, OR | 17,770 | 17,769 | 25,129,278 |
| Vancouver, WA | 3,478 | 3,468 | 2,734,575 |
| Coos Bay, OR | 3,533 | 3,518 | 6,781,386 |
| Grays Harbor, WA | 20,274 | 20,286 | 3,272,635 |
| Port Angeles, WA | 13,678 | 13,679 | 1,811,485 |
| Tacoma, WA | 22,725 | 22,786 | 13,246,939 |
| Seattle, WA | 68,203 | 68,192 | 17,805,168 |
| Bellingham, WA | 32,789 | 32,745 | 1,977,776 |

## 2. Northern California

### a. Physical Environment

### (1) Geology

California, in late Cenozoic time, was dominated by intense faulting, volcanism, and marine to nonmarine conditions associated with the interaction of plate boundaries. The Farallon Plate which lies between the converging North American and Pacific plates, was being subducted along the western margin of the North American Plate. Following the contact of the North American and Pacific plates, subduction was replaced by right-lateral strike-slip faulting (Atwater, 1970). Strike-slip faulting along the San Andreas and associated faults persists as far north as Cape Mendocino. Presently, north of the Cape the Gorda Juan de Fuca Plate is being subducted.

Granitic and gneissic basement rocks of the Salinian block (Reed, 1933; Page, 1970) underlie the central third of the Central and Northern California shelf. This block is separated from the Cordilleran on the west by the Sur-Nacimiento fault. Ross (1978) indicated the Salinian block is an allochthon surrounded, and probably underlain by Franciscan rocks (Ross and McCulloch, 1979). Caught between two major plates, right-lateral shear forces on the Salinian block have produced considerable internal strike-slip faulting.

North and south of the Salininan block at the shelf is considered to be underlain by the Franciscan assemblage (Jurasic, Cretaceous, and early Tertiary marine metassediments). Indications are that these marine sediments were once more deeply buried, and a large portion of their erosional history occurred in the late cretaceous or early Tertiary (Hoskins and Griffiths, 1971). Subsequent marine sedimentation proceeded through early Tertiary time, but renewed deformation and erosion left only remnants of the lower Tertiary deposits. These deposits covered most of the present continental shelf and, in places, part of the adjacent slope.

Deformation through the mid-Tertiary was related to subduction; however in upper mid-Miocene time, a change in tectonic forces initiated the formation of the continental shelf and the present shelf basins. Basement ridges were generally uplifted along the outer margins of the shelf (Curray, 1966) to form the seaward margins of the shallow basins. The shelf basins acted as sites of maxium deposition for marine sedimentation until late Pliocene time. Most basins contain down-to-basin normal or high angle reverse faults along their eastern margins, and exhibit late Tertiary or Quarternary compressional folding.

These geologic basins: Eel River, Point Arena (northern California), Bodega, Ano Nuevo (Santa Cruz), La Honda (Outer Santa Cruz) (Central California), and Santa Maria Basins (Southern California) are situated on the continental shelf or partially on the adjacent continental slope. Clifton, (1980) provides a detailed discusison on the geologic features of these basins.

The Northern California planning area is in the offshore portion of the Coast Ranges geomorphic province and structural folds and faults tend to trend northeastsoutheast to north-south parallel to the alignment of the basin axes. The Eel River basin offshore extends northward from the Mendocino Fracture Zone to Cape Blanco in southern Oregon. Sediments in the basin overlying metamorphic Franciscan basement rock include rocks of Cretaceous and early Paleogene age which are separated from late Neogene age rocks of the "Wildcat Group" by a major unconformity.

The Point Arena basin is bounded on the east by the San Andreas fault, on the west by the Oconostota uplift (Curray, 1966; Silver and others, 1971), on the south by the Gualala uplift, and on the north by the Mendocino Fracture Zone. Although rocks of Paleogene age are present in the basin, the younger portion has been removed by erosion during uplift in late Paleogene time. These older rocks are overlain by a thick section of Neogene rocks which ranges from earliest Miocene through Quaternary Age.

### (2) Geologic Hazards

Geologic hazards for the basins in the Northern California shelf have been described by Clifton (1980), and Field, et. al., (1980), and McCulloch et. al., (1982). The Geologic Hazard Visual for OCS Lease Sale No. 73 (MMS, 1983) is a composit of maps contained in reports cited above. The visual provides a regional scale representation of the geologic hazards for Northern California. Geologic hazards are defined as existing or potential geologic features or processes that could inhibit the safe exploration and development of oil and gas resources. Most geologic hazards are potential rather than continuous and actual hazards. Potential geologic hazards identified offshore northern California are high incidence of seismicity, active faults, mass transport of sediments, steep slopes and steep-walled submarine canyons, buried and filled channels, hydrocarbon seeps, shallow gas, and gas-charged sediments. See Section IV.A.8., Effects of the Physical Environment on the proposed action, for a generic discussion of each hazard.

#### (a) Seismicity

The northern California OCS is within the circum-Pacific volcanic and seismic belt that has been active throughout Middle and Late Cenozoic time. Earthquakes in northern California have been instrumentally recorded by the University of California, Berkeley, since 1887. Numerous earthquakes of magnitude 5 and greater have been recorded in coastal and offshore California.

The San Andreas fault and the Mendocino Fracture Zone border the Point Arena Basin on the east and north, respectively, and the Mendocino Fracture Zone borders the Eel River basin on the south and, therefore, may be expected to experience seismically-induced ground motion. The expected maximum bedrock accelaration for offshore northern California during a 100-year period is between 0.1g and 0.2g and about 0.6g during a 2,500-year period (Thenhaus and others, 1980).

#### (b) Faults

The San Andreas fault extends northwest along the entire central California coast to Cape Mendocino where it bends westward and extends offshore to merge with the Mendocino fracture zone (Figure III.C.2.a.(2)-2). Maximum probable earthquake in this area is estimated to be magnitude 8.3 (Greensfelder, 1974; Smith, 1975).

### (c) Mass Transport

Evidence of slope failure is common the continental shelf and slope of northern California. Two large (≤67.5 sq mi [≤175 sq km]) and several smaller masstransport deposits have been mapped in the offshore Eel River basin (Field and others, 1980; Richmond and others, 1981). Field and others (1980) have also identified several zones of unstable surface sediments within the Eel River basin which show indications of initiation of slope failure. Rubin (McCulloch and others, 1980) has identified areas along most of the continental slope between Point Arena and Point Reyes in which slumping is occurring or has recently occurred.

Slump deposits are common in the submarine canyons offshore California and result from the undercutting of terrace and levee deposits by currents or by sediment transport in the canyons. The intermittent channel fill in the canyons is highly mobile and unstable.

### (d) Slopes

Moderate (5°) to steep slopes (greater than 10°) occur along the entire length of the continental slope off northern California. Steep slopes also occur on the Gorda Escarpment of the Mendocino Fracture Zone, and on the flanks of the major bedrock highs. Steep slopes may also occur locally within the many submarine canyon systems. Buried channels also are found in submarine canyon systems and fans.

### (e) Hydrocarbon Seeps

Seeps offshore northern California are generally associated with shallow or active faults, shallow gas zones, and exposed or thinly covered bedrock. Water-column anomalies on high-resolution seismic profiles, indicating possible hydrocarbon seeps, occurred exclusively on the shelf and upper slope in water depths less than 705 ft (215 m) in the OCS Lease Sale No. 53 areas (Richmond and Burdick, 1981).

### (f) Shallow Gas

Shallow gas zones offshore northern California are most commonly associated with fault zones and structurally complex zones and are uncommon in undeformed sediments.

Gas-charged sediments are generally confined to the outer shelf and shelf bank regions off northern California where they most commonly occur in extensive zones associated with seaward-dipping beds at shallow depth.

## (3) Non-Petroleum Mineral Resources

### (a) Sand and Gravel

Many varieties of non-petroleum resources are located in the ocean and on or beneath the ocean floor. Contained on the northern California continental margin are vast quantities of sand and gravel and associated heavy mineral deposits and phosphorite. The most exploitable of these resources along the northern California Coast are the beach and nearshore deposits of sand and gravel.

### (b) Precious and Base Metals

A description of the heavy mineral concentrations along the northern California coast can be found in Phillips (1979). Phillips (1979) reports that the heavy minerals and elements, from the coastal region are gold, platinum, zircon, sphene, rutile, magnitite, ilminite, chromite, urano-thorite, cassiterite, apatite, diamond and barite. Most of these deposits occur on the present beaches.

Heavy-mineral data is only available for part of the northern California shelf. Investigations by Moore and Silver (1968) identify two small areas with greater than 10 percent heavy minerals offshore from Crescent City. Analyses of surficial sediments identifies four areas that contain more than 10 parts per billion gold. The high gold areas lack a close correlation to water depth, but may be related to gold bearing Cenozoic strata. Moore and Silver (1968) suggest that the offshore gold accumulations are large concentrates produced from the Cenozoic deposits by wave erosion during the post galcial rise in sea level. The two southern concentrations do occur off river mouths draining gold bearing terrain.

The two heavy-mineral concentrations on the northern California shelf with greater than 10 percent heavy minerals only cover an area of 20 square kilometers or 8 square miles.

### (c) Polymetallic Sulfides

The Gorda Ridge is a mid-oceanic ridge system located off the coast of northern California. Recent theories on the tectonic setting of different types of ore deposits indicates that this area may have a potential for hydrothermal proximal deposits. Mineral assemblages associated with these deposits can include copper, zinc, silver, lead, iron, sulfur and silicon. For a more detailed discussion on the Gorda Ridge see Section III.C.1.a.(3).

## (4) Oceanography

### (a) Chemical Oceanography

Chemical oceanography of the northern California planning area is discussed briefly below. Detailed reviews of the chemical and temperature characteristics of the northern California coast waters may be found in Winzler and Kelly (1977), Jones and Stokes (1980), U.S.D.I. (1980), Emery, (1960), and numerous CalCOFI publications.

Surface waters in the California current are generally saturated down to the thermocline with oxygen which then decreases to an oxygen minimum layer between 700 m. and 100 m. Below the oxygen minimum layer, there is a gradual increase in oxygen content with depth with the oxygen level of deep waters being relatively constant for hundreds of meters. Oxygen levels vary from surface saturated levels of 7 to 6 ml/l to 0.4 ml/l at the oxygen minimum layer and increasing to 2.6 ml/l at 2000-3000 meters.

The concentration of nutrients characterizing marine waters: phosphate, nitrate, and silicate fluctuate with season and depth, the highest surface levels of nutrients being found during the upwelling season. Terrestrial sources of nutrients include major sewage outfalls of urban areas along the coast and areas of agricultural runoff (nutrients from fertilizers). An extensive data base on nutrient levaels in California marine waters is contained in the CalCOFI investigations.

### (b) Physical Oceanography

Hydrographic Conditions: The oceanographic conditions along the northern California coast, like those in the Washington and Oregon Planning area, are influenced by the California Current System, and precipitation and river runoff. Dodimead et al. (1963) suggest that this region is dominated by the Transitional Domain but also influenced by the Coastal Domain.

The meteorology and physical oceanography of the central and northern California coast have been reviewed in detail in A Summary of Knowledge of the Central and Northern California Coastal Zone and Offshore Areas prepared by Winzler and Kelly Consulting Engineers for the Bureau of Land Management (August 1977).

Large Scale Circulation: The circulation along the northern California coast is generally regarded as the least well understood of any area along the U.S. West Coast. The Coastal Ocean Dynamics Experiment (CODE) and Super CODE programs have, however, provided a number of current meter records and drifter tracks in the region between Bodega Bay and Point Arena for the period of 1981 through 1983 (Rosenfeld 1983; Davis 1985a, 1985b; Denbo, et al. 1984). The CalCOFI observations which provided the bulk of temperature and salinity observations along the California coast are sparse in the Northern California Planning Area (Lynn, et al., 1982).

The average flow at the surface appears to be southward during summer and northward during the winter. The California Undercurrent carries northward water characterized by the relatively high salinity and temperature associated with the tropics. There are not enough direct observations of this current in this region to establish the degree of its continuity in either time or space.

Factors Influencing Circulation: The offshore wind field in the winter in the Northern California Planning Area is dominated by a generally eastward average wind and frequent North Pacific storms. Strong northward winds are associated with the passages of cold fronts, propagating eastward out of the North Pacific. The integrated effect of such frontal passages and the larger scale average wind produce the northward surface current seen in winter. The steady northwesterly winds seen in summer produces the long-term average southward surface current in summer, along with the offshore flow features associated with upwelling.

Inference from observations on the Washington and Oregon shelf as well as modeling results (Dynalysis, 1985) suggest that coastally trapped waves contribute to the variability seen in the currents measured along the coast. Also, variability in the density and velocity fields, observed in this area by the CODE program, have been attributed to internal waves propagating onshore (Howell and Brown, 1985).

Modes of Variability: The season cycle is dominated by the large scale wind field with eastward and northward winds producing an onshore transport during the winter. During the summer the upwelling favorable winds (southward) occur and persist through the fall. Huyer (1984) states that northern California, between Point Arena and Point Reyes has the strongest upwelling favorable winds in the entire California Current System, and that this region exhibits the most persistent upwelling seen anywhere on the coast.

Year-to-year or interannual variability in the California Current System off the northern California coast is at least as large as the seasonal signal. This variability is seen in coastal sea level, currents, and hydrographic conditions (temperature and salinity) and the largest signal is that associated with El Nino (Chelton and Davis, JPO, 12(8), 1982; Huyer and Smith, JGR 90 (C4), 1985).

Variability which occurs over time frames less than seasons, i.e., short-term variability, is largely associated with synoptic wind events. These are often the strong upwelling favorable "pulses" of wind seen along the U.S. West Coast in summer. These can encite poleward propagating "coastally trapped" waves (Dynalysis, 1985). As Moores and Robinson (1984) point out, in this region the "instantaneous California current is seen to consist of intense meandering current filament (jets) intermingled with synoptic-mesoscale eddies. These quasi-geostrophic jets entrain cold, upwelled coastal waters and rapidly advect them far offshore...."

### (5) Water Quality

Water quality off the coast of Northern California is generally excellent (Miller and McGrew 1977). However, Humboldt Bay is contaminated from a variety of wastes that include shipping, timber, industry and fish processing. Results of the "mussel watch" program (Stephenson, Martin and Martin (1978), which evaluates toxicant concentrations in *Mytilus* sp along the entire California coast indicate that open coast waters off nothern California are pristine. As described for the other Pacific coast planning regions, water quality parameters along the central California coastline are affected by upwelling during the summer months when coastal waters have lower dissolved oxygen and higher nutrients and carbon dioxide concentrations as deeper, cooler water is advected vertically into shallow depths. besides the population and industrial influence in Humboldt Bay, water quality is affected to a negligible degree by runoff from agricultural lands and rivers, and materials from boats and ships. As indicated in section IV.B.7a(3)(a), the plume from the Columbia River may have a limited effect ocean waters off north+rn California during summer months.

### (6) Ocean Dumping Off the coast of northern California,

there are 7 designated historic and active dump sites (See Table IV.B.8.a.(1)(d)-1 and Figure III.C.2.a.(6)-1. The materials dumped at each of these sites depends upon the type of permit which was issued for that site by the Environmental Protection Agency. The waste materials which have been dumped in the ocean have consisted of substances such as low level radioactive waste, obsolete munitions, industrial waste, toxic chemicals and dredge spoils.

Low level radioactive waste is comprised of tools, gloves, transport containers, and other articles which have been contaminated. Low level waste contains on the average less than one curie of activities per cubic foot of material, which allows for "hot spots" where the contamination may be many times the average level (Lipshutz, 1980).

Upon release to the marine environment, radioactivity can progress up through the food chain with the associated bioaccumulation of the radiation.

In northern California waters, there are 6 active dredge spoil sites. Three of these sites are in State waters with one at Crescent City, one off Humboldt Bay, and one off Fort Bragg. The three sites on the Federal OCS are: one off Fort Bragg, one off Humboldt Bay and one off Crescent City. There is one designated radioactive dump site off northern California. This site is more than 250 miles off Cape Menodocino. Of the 7 sites off northern Califonria, 3 are within 3 nm of land with the remaining 4 sites on the Federal OCS.

The U.S. Navy is considering at-sea disposal of decommissioned, defueled nuclear submarines. One location under consideration for submarine disposal is approximately 125 nm off Fort Bragg in water depths of 4,100 to 4,500 meters (13,50014,300 feet). For detailed information see DEIS on the Disposal of Decommissioned Defueled Naval Submarine Reactor Plants, U.S. Dept. of the Navy, December, 1982.

### (7) Climate

The climate of the northern California coastal area is marine in character with cool, dry summers and mild, wet winters. The area is primarily dominated by the North Pacific Subtropical High pressure system. The Pacific High is most dominant in the summer when it is located to the west and north of California and reaches its greatest intensity and size. This results in dry, stable weather which prevails from May through September. In the fall, the high pressure system starts to weaken and migrates

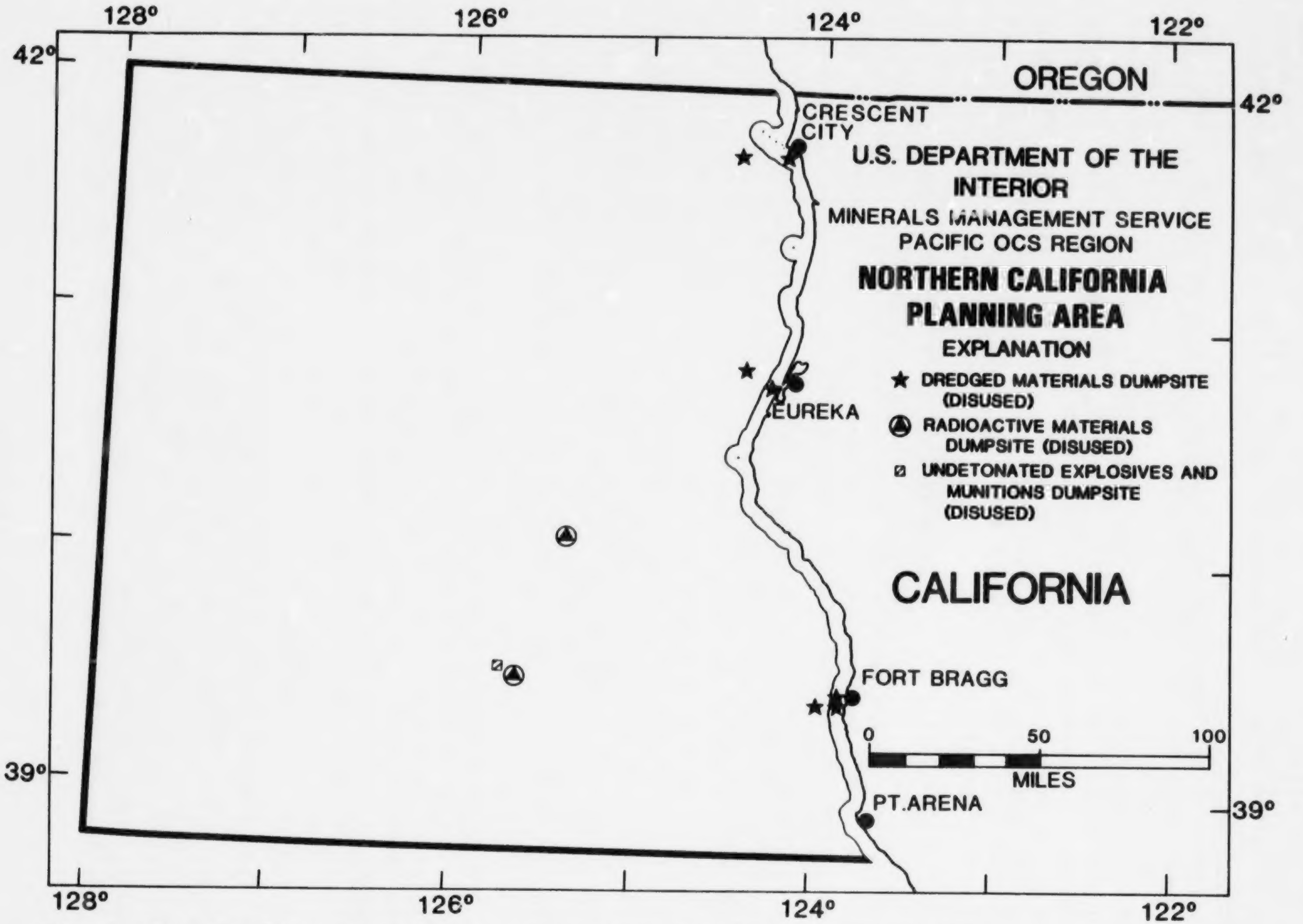

128°
126°
124°
122°
42°
39°
OREGON
CRESCENT CITY
U.S. DEPARTMENT OF THE INTERIOR
MINERALS MANAGEMENT SERVICE
PACIFIC OCS REGION
NORTHERN CALIFORNIA PLANNING AREA
EXPLANATION
★ DREDGED MATERIALS DUMPSITE (DISUSED)
RADIOACTIVE MATERIALS DUMPSITE (DISUSED)
UNDETONATED EXPLOSIVES AND MUNITIONS DUMPSITE (DISUSED)
EUREKA
CALIFORNIA
FORT BRAGG
PT.ARENA
0
50
100
MILES

Figure III.C.2.a.(6)-1. Dumpsites in the Northern California Planning Area.

southward. Pacific storm systems frequently pass through the area in winter bringing periodic cloudiness and precipitation. Almost all of the annual rainfall occurs in the period of October through April.

Winds are primarily from northwesterly directions. Average wind speeds range from 10 to 20 knots (nautical miles per hour), with winds generally increasing from south to north. Winds are generally westerly in the winter season and northwesterly to northerly in the summer season.

Temperature inversions (conditions in the atmosphere where temperatures increase with height) occur frequently along the California coast, particularly in the summer season. This results in limited vertical dispersion of air pollutants.

However, horizontal dispersion of air pollutants is often favored by the fairly strong winds that frequently blow in the coastal areas.

#### (8) Air Quality

Air quality in most of the coastal areas of northern California is generally good. Ozone levels are below the national standard, but do occasionally exceed the State standard (0.10 ppm). Ozone is generated by photochemical reactions involving nitrogen oxide and hydrocarbon pollutants, and is almost primarily a summertime phenomenon. Total suspended particulate concentrations do not exceed national ambient air quality standards. However, the California ambient standard is exceeded at many locations. Concentrations of nitrogen dioxide, carbon monoxide, and sulfur dioxide are below ambient standards in all areas.

### b. Biological Environment

(1) Plankton (See discussion of plankton for Washington and Oregon planning area and Southern California Planning area).

#### (2) Benthos

##### (a) Intertidal Benthos

According to the county-by-county tabulation of shore type, the extent of rocky shores and sandy beaches is approximately equal in northern California.

###### (i) Rocky Intertidal

Scientific literature on rocky intertidal communities in northern California is spotty. Much of the coast has not been systematically studied. Woodward and Clyde (1982), however, has surveyed the entire area from helicopter.

The planning area is within the Oregonian biogeographical province which begins at Pt. Conception and extends to Puget Sound, Washington or Prince William Sound, Canada depending on the author (Valentine, 1966).

Literature on rocky intertidal species distribution indicates that the change in species composition and species distribution in Central and Northern California is not major (Stephenson and Stephenson, 1972; Woodward and Clyde, 1982).

The Minerals Management Service (1983) has listed the sensitive rocky intertidal areas of northern and central California (Table III.C.2.b.(2)-1).

### (ii) Sandy Intertidal

Because of the continued restructuring of sandy beaches, the number of individuals per species varies greatly from year to year. There is, however, a characteristic group of animals which live just below the low tide line or within the sand between the tide lines. A few organisms even live higher up on the beach in burrows or beneath organic debris. Additional general comments on sandy beach ecology are presented by Cubit (1969), MacGinitie and MacGinitie (1949), Ricketts, et al., (1968), and Trask (1970).

Accounts dealing with sandy area in northern California are few. Although Allen (1964) collected 20 species in northern California, only the mole crab was collected every year (1958 to 1961); the other species were absent or in low abundance at least one of the years studied. As few as 3 to 5 species were collected at a site, while the maximum collected per site was 18, far fewer than rocky intertidal areas.

A species of recreational and economic importance, the razor clam *Siliqua patula*, typical of the northern regions, should be mentioned as important members of this habitat.

### (b) Subtidal Benthos

The continental shelf of northern California gradually slopes to the continental slope. Although it is periodically cut by canyons or interrrupted by biologically important shallow banks or sea mounds, the shelf along northern California is a typical continental shelf in contrast to the atypical southern California continental shelf. The sediment of the northern California shelf generally grades from coarser sandy sediment in shallow water near shore to finer silt and clay substates in the deeper waters near the margin. The benthic invertebrates similarly grade from filter or suspension feeders on sandy substates to deposit feeders in finer sediments. Although little information is available on the bottom communities of the region, it is reasonable to assume that they are productive and diverse owing to the indirect evidence of abundant upwelling and high fisheries landings. The presence of endemic species is not well known, but is assumed to be less than in southern California.

The subtidal benthic communities and assemblages of northern California are not well known. A comprehensive literature survey by Winzler and Kelly Consulting Engineers (1977) summarized previous benthic studies in the central and northern California region. Other studies have been conducted

## TABLE III.C.2.b.2-1

## SENSITIVE ROCKY INTERTIDAL AREAS OF NORTHERN AND CENTRAL CALIFORNIA BASED ON ISOLATION, FLAT PLATFORMS AND DISTANCE OF CONTINUOUS HABITAT WITHOUT SIGNIFICANT INTERRUPTION

### Northern California

(1) Point St. George, Pebble Beach -
Heavy concentration of stocks ranging in size from one meter diameter to actual vegetation supporting island, one supporting a tree. Also isolated north and south from other rocky intertidal areas by sandy beaches.

(2) Patricks Point to Trinidad Head ASBS -
A lot of surface area available for communities, although communities not exceptionally rich. Also isolated north and south from other rock intertidal areas by sandy beaches.

(3) Rockport to Westport -
Certain areas between these towns have broad flat rocky platforms.

(4) Fort Bragg to Fort Ross -
Within this stretch of coast are extremely convoluted rocky shores having broad flat intertidal platforms. The most outstanding of these areas of secondary concern are listed as follows:

- Just north of Fort Bragg
- Soldier Point Area
- Hare Creek Bay
- Casper Point
- Point Cabrillo
- Mendocino Bay to Van Damm Beach
- Arena Cove
- Saunders Landing (and Reef) to Iverson's Point
- Robinson Point

### Central California

- Gualala Point to Black Point off Sea Ranch (include Gerstle Cove ASBS)
- North West Cape

(5) Mussel Point to Bodega Head -
Extensive numerous flat intertidal platforms. Isolated north and south from other rocky intertidal areas by sandy beaches.

(6) Point Reyes Headlands -
Very abundant flora and fauna, particularly dense mollusk populations.

(7) Agate Beach and Duxbury Reef -
Largest flat intertidal reef in California with some isolation north and south from other rocky intertidal areas. Giant mussel populations.

## TABLE III.C.2.b.2-1 (cont.)

## SENSITIVE ROCKY INTERTIDAL AREAS OF CENTRAL CALIFORNIA BASED ON ISOLATION, FLAT PLATFORMS AND DISTANCE OF CONTINUOUS HABITAT WITHOUT SIGNIFICANT INTERRUPTION

(8) Farallon Islands -

Rocky area isolated from other rocky intertidal areas by approximately 15 miles.

(9) James Fitzgerald Marine Reserve through Piller Point -

Broad flat rocky platforms. Highly productive intertidal stretch of coast extending for 5 miles. Similar assemblages to Duxbury Reef.

(10) Ano Nuevo Island -

Extensive flat intertidal platforms.

(11) Monterey Peninsula -

Has 80% of known flora of the western coast of North America. Is a major biogeographic transition zone. High density of invertebrates, including mollusks. Summer fog prevents dessication to organisms at low tide. Historic scientific area. Includes areas semi-protected from large Pacific waves (Pebble Beach).

Flat intertidal platforms on Monterey Peninsula include:

Table Rock Area -
and
Needle Rock Point -

Pacific Grove Marine Gardens ASBS -

Important intertidal area; one of the best studied in the country, partly because of its great diversity of species and richness.

Cypress Point -
and
Point Pinos -

Along 17 Mile Drive, Monterey Peninsula, the two areas which stand out, having the broadest flat rocky platforms along a stretch of coast, and having a relatively continuous rocky intertidal with scattered flat platforms.

(12) Carmel River State Beach to Soberanes Point (including Point Lobos Reserve) -

Many deep coves giving a lot of surface area to intertidal habitats. Several semi-protected areas including Whaler's cove. Only rich population of intertidal macroalgae *Eisenia* in central-northern California (Point Lobos Reserve).

and include Allen (1964), Johnson (1971) and Odemar, et al., (1968); however, most of these are relatively localized in scope and tend to focus on areas close to shore.

### (3) Fish Resources

Roughly 485 fish species are found in this planning area (Miller and Lea, 1972 and Winzler and Kelly, 1977). Although species common farther south are occasionally observed in this area, it tends to be more like Oregon and Washington. Cape Mendocino, near the southern end of the planning unit, is the commonly accepted natural boundary between the northern and southern northeastern Pacific. Areas of upwelling are common off this stretch of coast.

The continental shelf is relatively narrow through the planning area. The eastwest trending Mendocino Escarpment is the major submarine topographic feature off the west coast of the United States. Several submarine canyons are located in the planning area. Most of the coastline, and hence the shallow benthic zone, is rocky and steep. Sandy areas are usually short and narrow. There are no major offshore islands. Kelp beds are sparse and small.

Major epipelagic fishes include Pacific lamprey, Pacific herring, Pacific sardine, northern anchovy, Pacific salmons (mostly chinook with some coho), jack mackerel, Pacific mackerel, and albacore tuna.

Common offshore benthic species include white sturgeon, Pacific hake, Pacific cod, rockfishes, sablefish, lingcod, and flatfishes. Shallow (inshore) benthic species common to sandy bottoms include sharks, skates, rays, sturgeons, smelts, white croaker, surfperches, and flatfishes. Rocky bottomed shallow benthic areas are frequented by, among others, rockfishes, lingcod and other greenlings, sculpins, blennies, and eels. See Table III.C.2.b.(3)-1 for a list of representative fishes and their habitats for northern California.

### (4) Marine Mammals

The following information is excerpted fron Center for Marine Studies (1983).

The marine mammal fauna of central and northern California includes at least 21 species of whales, dolphins, and porpoises, (the cetaceans), together with 5 species of seals and sea lions (the pinnipeds), and the southern sea otter. The waters of central and northern California are a meeting ground where populations of animals having different biogeographic affinities intermingle.

Among each group of animals may be found species representative of widespread communities found in the cooler waters of the North Pacific. Off California, these boreal species occur primarily during winter through early summer in areas of coastal upwelling and in the coolest waters of the California Current. Included among them are Dall"s and harbor porpoises,

Table III.C.2.b.(3)-1

## REPRESENTATIVE FISHES AND THEIR HABITATS, NORTHERN CALIFORNIA

| Species | Habitat | | | |
|---|---|---|---|---|
| | Epipelagic | Benthic | | |
| | | Shallow | | Offshore |
| | | Sandy | Rocky | |
| Pacific lamprey | X | | | |
| Pacific electric ray | | X | | X |
| Bigskate | | X | | |
| White sturgeon | | X | | X |
| Pacific herring | X | | | |
| Pacific sardine | X | | | |
| Northern anchovy | X | | | |
| Pacific salmons (5 spp) | X | | | |
| Steelhead trout | X | | | |
| Surfsmelt | X | X | | |
| Eulachon | X | | | |
| Night smelt | X | | | |
| Pacific hake | | | | X |
| Pacific cod | | | | X |
| Pacific saury | X | | | |
| Rockfishes (sev spp) | | | X | X |
| Sablefish | X | | | X |
| Lingcod, other greenlings | | | X | X |
| Sculpins (sev spp) | | | X | |
| Jack mackerel | X | | | |
| White croaker | | X | | |
| Surfperches (sev spp) | | X | | |
| Wolf eel | | | X | |
| Monkeyfaced-eel | | | X | |
| Pacific mackerel | X | | | |
| Albacore tuna | X | | | |
| Pacific butterfish | | X | | X |
| California halibut | | x | | x |
| Curlfin turbot (sole) | | X | | X |
| English sole | | X | | X |
| Butter sole | | X | | X |
| Starry flounder | | X | | X |
| Rex sole | | X | | X |
| Dover sole | | X | | X |
| Petrale sole | | X | | X |

and northern fur seals. Also present off central California in late summer and autumn are representatives of communities found in warmer waters to the south. These include California sea lions and northern elephant seals among the pinnipeds, as well as bottlenose dolphins and pilot whales. Many species of cetaceans are widespread in occurrence throughout the North Pacific. Both harbor porpoises and harbor seals tended to be most abundant close to shore in the northern California planning area. At sea most sea lions, harbor seals, sea otters, and harbor porpoises are found predominatly in waters overlying the continental shelf (to the 200 m isobath). Most cetacean species and the northern elephant seal occur in greatest numbers in waters overlying the continental slope (200 m to 2,000 m depths). Two species of marine mammals--the sperm whale and the northern fur seal--prefer offshore waters (greater than 2,000 meters depth). Details on endangered species are tabulated in Section III.C.2.b(6)-1

### (5) Seabirds

The following information is excerpted from Center for Marine Studies (1983). A least 102 species of seabirds are found off northern and central California. The ashey storm-petrel is endemic to California. Its small world population is centered on the Farallon Islands. Brandt's cormorant and the western gull are restricted to the waters of the California Current and attain high population levels off central and northern California.

Seabirds may number as many as 6.5 million at once in autumn and early winter, and they may consume up to 200,000 metric tons of fish, squid, and plankton in a single year. Several species, including shearwaters, phalaropes, and brown pelicans, concentrated preferentially for feeding in thermal fronts bordering coastal upwellings.

Seventeen species of seabirds presently nest in central and northern California; prior to 1983 their aggregate numbers had been increasing due to growth of the population of common murres. Total nesting numbers in 1982 were on the order of 850,000; most of which were murres (519,000), Brandt's cormorants (58,000), Cassin's auklets (109,000), and Western gulls (40,000).

The most important nesting colonies in the northern California planning area are at Castle Rock and south to Trinidad Head. The greatest offshore concentrations of seabirds occur over the relatively broad continental shelf areas north of Cape Mendocino.

### (6) Endangered and Threatened Species

The northern California planning area is utilized by several State and Federally listed threatened and endangered species which may be affected by proposed offshore lease sales and development. Those species most commonly listed for the northern California area include seven endangered whale species, three endangered and one threatened species of turtle, the endangered California Brown Pelican, American Peregrine Falcon, the Bald Eagle, California Least Tern and Aluetian Canada Goose.

See Table III.C.2.b.(6)-1 for a more detailed listing of species and their distribution.

### (7) Estuaries and Wetlands

Estuaries are very important to the continental shelf ecology in northern California, serving as spawning or nursery grounds for marine fish and invertebrates, habitat for many oceanic birds, and as suppliers of nutrients to the nearshore environment.

There are 47 estuaries of ecological concern in the central and northern California planning area. These estuaries, together with some of their characteristics are shown in Table III.C.2.b.(7)-1., BLM (1980).

Criteria for the inclusion of estuaries on this list were major anadromous fish streams (California Fish and Game, 1973) and the Jones and Stokes (1980) tables labeled Areas of Ecological Concern (Volume IV Watersheds and Basins).

Out of 47 estuaries of concern, 29 (62 percent) occur north of San Francisco. All estuaries are considered important bird feeding areas, but northern California estuaries are more important as fish nursery areas and anadromous fish routes. Seventy nine percent of the estuaries north of San Francisco are important nursery areas (versus 35 percent to the south) while 62 percent of the northern estuaries are important anadromous fish streams compared with 47 percent in southern California. More estuaries are open year round in northern California (48 percent) than in central California (24 percent), reflecting the greater amount of rainfall and importance of the estuaries north of San Francisco.

Important references concerning estuaries of northern California are the Summary of Knowledge report by Winzler and Kelly (1977), and the characterization report by Jones and Stokes (1980). Estuaries are also covered by U.S. Department of the Interior (1978a, 1979, 1980). Individual estuaries have been given detailed coverage by California Department of Fish and Game (CDFG) as part of their wetland series as follows:

Humboldt Bay (1973)
Eel River (1974b)
Lake Earl and Smith River (1975b)

### (8) Areas of Special Concern

There are three types of designated areas of special concern which are of biological importance. They are: 1) ecological reserves, 2) marine life refuges, and 3) area(s) of special biological significance (ASBS) controlled by the State of California . Ecological reserves and marine life refuges are very similar; however, there are more restrictions and controls in an ecological reserve. The purpose of the refuges and reserves is to reduce the abuse and waste of the State's tidepool resources by restricting general collecting of all animals living in tide pools and

TABLE III.C.2.b.6-1
Coastal and Marine Endangered Species That Could
Potentially Be Affected by OCS Oil and Gas Exploration or Development[5]

| Common and Scientific Names | Status[1] Jurisdiction[2] | Migrant, Resident or Semiresident | Range/ Occurrence[4] | Remarks |
|---|---|---|---|---|
| Gray whale (*Eschrichtius robustus*) | E<br>NMFS | Migrate nearshore south, Nov-Feb; north, Feb-May (cow/calf pairs usually last, nearest shore). | Primarily coastal migration from summer feeding grounds in Alaskan water to winter breeding/calving grounds in Baja, California. | Bottom invertebrate feeders but mostly fast during migration. Possible small summer feeding groups off northern California. |
| Humpback whale (*Megaptera novaeangliae*) | E<br>NMFS | Strongly migratory. | Summer Bering Sea to Pt. Conception along Continental Shelf. Usually nearshore. Easternmost stock breeds/calves Baja, California and Mexico. | Some summer feeding in Gulf of Farallones. Gregarious. Surface fee on summer grounds. |
| Sperm whale (*Physeter catadon*) | E<br>NMFS | Weakly migratory. Segregate strongly by sex and age. Large solitary bulls may migrate from tropics/ temperates to near polar pack ice. | Primarily over continental slope during winter. Summer in N. Pacific. Males in Bering and Chukchi Seas. Females south of lat 50°N. | Deep diving to 1000m. Primary food squid, some octupus and fish. Groups to 50. |
| Blue whale (*Balaenoptera musculus*) | E<br>NMFS | North-south movement evident, but seasonal distribution and migration routes not well known. | In eastern North Pacific range along edge of continental slope and further offshore from the Aleutian Islands to Central America. | Feed on krill (euphausid at depths around 100m. Single or in groups of 2 or 3. |

### TABLE III.C.2.b.6-1 (Con't)
### Coastal and Marine Endangered Species That Could Potentially Be Affected by OCS Oil and Gas Exploration or Development[5]

| Common and Scientific Names | Status[1] Jurisdiction[2] | Migrant, Resident or Semiresident | Range/ Occurrence[4] | Remarks |
|---|---|---|---|---|
| Fin whale (Balaenoptera physalus) | E<br>NMFS | In eastern N. Pacific migrates from Baja California north to Bering Sea appearing Mar off Vancouver Island. | Worldwide distribution. Northeast seasonal movement pattern as yet undefined. In winter species is often found in offshore waters from Central California to Baja, California. | Versatile feeders: krill herring, capelin, polloc and squid. Single or po to 6 or 7. |
| Right whale (Eubalaena glacialis) | E<br>NMFS | No apparent rigid migration schedule or well-defined migration route. | Thought to migrate from Alaskan waters to continental coasts and Baja, California. | Single whales sighted tw in California waters in last 15 years. |
| Sei whale (Balaenoptera borealis) | E<br>NMFS | North-south movement of eastern N. Pacific part of population documented. | Throughout North Pacific in pelagic waters and are rare inside boundaries of continental shelf. Widely distributed but sparce. | Copepods, some euphausid squid, and small schooli fish. Single or pods of 2-5. |
| Guadalupe Fur Seal | P<br>NMFS | Wooders to southern California. Possible breeding colony developing on Sna Miguel Island. | Breeds Isle de Guadalupe off Baja, CA. Adults on island all year. | |

TABLE III.C.2.b.6-1 (Con't)
Coastal and Marine Endangered Species That Could
Potentially Be Affected by OCS Oil and Gas Exploration or Development[5]

| Common and Scientific Names | Status[1] Jurisdiction[2] | Migrant, Resident or Semiresident | Range/ Occurrence[4] | Remarks |
|---|---|---|---|---|
| Southern sea otter (Enhydra lutris nereis) | T<br>FWS | Resident in CA from Ano Nuevo to Santa Maria River; seasonally or occasionally reported north to OR and WA, but identity not always confirmed and might be confused with Alaskan otters translocated to OR and WA in late 1960's and early 1970's.<br>WA and OR locations being considered as potential translocation sites for southern otters. | Occur nearshore, usually within 1/2 mile of shore, between Ana Nuevo Island and the Santa Maria River mouth. Use kelp beds extensively for feeding and resting. | Prefers to feed on urchi abelone crabs, and clams Other invertebrates are eaten. Occur singly or somewhat segregated grou based on sex and age. |
| Leatherback sea turtle (Dermochelys coriacea) | E (all) | Strong-swimming wanderer. | Random visitors to California waters. See MMS (1983) Table III.B.5-1 for more details. | |
| Green sea turtle (Chelonia mydas) | E (Pacific coast of Mex. breeding colony pop.)<br>T (all others)<br>NMFS/FWS | May be carried north of southern CA on warm currents. | Random visitors to California waters. See MMS (1983) Table III.B.5-1 for more details. | |
| Olive ridley sea turtle (Lepidochelys olivacea) | E (Pacific coast of Mex. breeding/ nesting grounds)<br>T (others)<br>NMFS/FWS | May be carried into CA waters on warm currents. | Random visitors to California waters. See MMS (1983) Table III.B.5-1 for more details. | |

## TABLE III.C.2.b.6-1 (Con't)
## Coastal and Marine Endangered Species That Could Potentially Be Affected by OCS Oil and Gas Exploration or Development[5]

| Common and Scientific Names | Status[1] Jurisdiction[2] | Migrant, Resident or Semiresident | Range/ Occurrence[4] | Remarks |
|---|---|---|---|---|
| Loggerhead sea turtle (*Caretta caretta*) | T (all)<br>NMFS/FWS | Potential visitor | Random visitors to California waters. See MMS (1983) Table III.B.5-1 for more details. | |
| Bald eagle (*Haliaeetus leucocephalus*) | F<br>FWS | Migration patterns poorly known; some move from less favorable breeding grounds to streams with large salmon runs. | Breed from AK to n. CA. Most OR/WA nests along marine coastlines within 200 m of shore. Nests mainly in interior CA, but some along coasts and on Santa Catalina Island. | Generally carrion feeder nests sites located sout of Grays Harbor, WA; nor and south of Columbia River estuary at and eas of Astoria, OR; and nort of Coos Bay, OR. |
| American peregrine falcon (*Falco peregrinus anatum*) | E<br>FWS | Nests in part along the coast. Migrates through and overwinters in WA, OR; nests throughout central CA coast section. | 13 territories along coastal CA; occurs often between OR and Mexico. | Nest locations not normally publicized to discourage interference. |
| Aleutian Canada goose (*Branta canadensis leucopareia*) | E<br>FWS | Winter resident | Leaves breeding grounds in Aleutians late Aug. Arrives Sacramento/San Joaquin Valley wintering grounds Oct. Leaves CA late Apr. | |
| California Brown Pelican (*Pelecanus occidentalis*) | E<br>FWS | Summer nesters southern California. Wanders north to Washington and south to Mexico. | Breeds on Anacapa and Santa Barbara Islands, CA. Moves N. and S. of breeding range between nesting seasons, | Visual feeders, dependen almost entirely on anchovies for food. |

## TABLE III.C.2.b.6-1 (Con't)
## Coastal and Marine Endangered Species That Could Potentially Be Affected by OCS Oil and Gas Exploration or Development[5]

| Common and Scientific Names | Status[1] Jurisdiction[2] | Migrant, Resident or Semiresident | Range/ Occurrence[4] | Remarks |
|---|---|---|---|---|
| California least tern (*Sterna albifrons browni*) | E<br>FWS | Summer nesters and visitors Feb. to mid-Oct. | Breeds from San Francisco Bay S. into Mexico, nesting in sparsely vegetated flat areas with loose substrate near estuaries with supplies of small fish. Nest late spring through summer. | Adults feed at sea; juveniles taught to feed in quiet waters. |
| Light-footed clapper rail (*Rallus longirostris obsoletus*) | E | Resident | Breeds and feeds in upper reaches of estuaries. | Major colonies are Carpenteria Marsh, Anaheim Bay, Upper Newpo Bay, San Diego and Mission Bays, Tijuana Slough and Baja, CA |
| California clapper rail (*Rallus longirostris obsoletus*) | E<br>FWS | Resident | In relatively unpolluted salt and brackish marshes of San Francisco Bay, San Pablo Bay, Napa Marsh, and Elkhorn Slough, CA. Nests mid-Mar. through Jul. | Occasional non-breeding vagrant Humboldt Co., CA Breeds and feeds in uppe reaches of estuaries. Platform nests built on near ground, usually in/ near tidal slough and dense growths of pickleweed. |
| Salt marsh harvest mouse (*Reithrodontomys raviventris*) | E<br>FWS | Year-round resident | Salt and brackish marsh areas of San Francisco and San Pablo Bays, CA, where dense vegetation (usually with pickleweed) occurs in combination with open ground. | |

## TABLE III.C.2.b.6-1 (Con't)
## Coastal and Marine Endangered Species That Could Potentially Be Affected by OCS Oil and Gas Exploration or Development[5]

| Common and Scientific Names | Status[1] Jurisdiction[2] | Migrant, Resident or Semiresident | Range/ Occurrence[4] | Remarks |
|---|---|---|---|---|
| Salt marsh bird's beak (*Cordylanthus maritimus* ssp. maritimus) | E<br>FWS | Resident | Small plant, member of stone crop family occurs in upper reaches of estuaries from Golita Slough to Baja, California. | |

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[1] All whales have baleen ("whalebone") for feeding except sperm whale, which has teeth.

[2] Status: Endangered (E), Threatened (T), Proposed (P).

[3] Jurisdiction: National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (FWS). For sea turtles, NMFS has jurisdiction when animals are in water; FWS, when animals are on land.

[4] Coastal (C): Shoreline to 200-meter (m) water depth;
Slope (S): water depths between 200 and 2,000 m;
Pelagic (P): water more than 2,000 m deep.

[5] Sources of information include Carr (1952), Bonnell (1983), Briggs (1983), Dohl et al. 1983, Leatherwood et al. 1982, Maser et al. 1981, Ryckmen et al. (1980a & 1980b), U.S. Fish and Wildlife Service (1981).

## TABLE III.C.2.b.(7)-1
## ESTUARIES OF ECOLOGICAL CONCERN IN NORTHERN AND CENTRAL CALIFORNIA

| Estuary | Opening to Sea (Northern California) | Bird Feeding Area (+) | Important Marine Fish Nursery Grounds (I) | Important Anadromous Fish Spawning Route |
|---|---|---|---|---|
| Smith River Delta | Open year round | + | + | + |
| Lake Earl/Lake Talawa | Intermittently Open | + | + | + |
| Klamath River | Open year round | + | + | + |
| Redwood Creek | Intermittently Open | + | + | + |
| Stone Lagoon | Intermittently Open | + | + | + |
| Dry Lagoon | Intermittently Open | + | - | - |
| Big Lagoon | Intermittently Open | + | + | + |
| Mad River | Intermittently Open | + | + | + |
| Humboldt Bay (including Arcata Bay) | Open year round--constant width, by jetties | + | + | + |
| Eel River | Open year round | + | + | + |
| Mattole River | Intermittently Open | + | - | + |
| Little River | Intermittently Open | + | - | +(minor) |
| Ten Mile River | Intermittently Open | + | + | + |

TABLE III.C.2.b.(7)-1 (Con't)
ESTUARIES OF ECOLOGICAL CONCERN IN NORTHERN AND CENTRAL CALIFORNIA

| Estuary | Opening to Sea | Bird Feeding Area (+) | Important Marine Fish Nursery Grounds (I) | Important Anadromous Fish Spawning Route |
|---|---|---|---|---|
| Noyo River | Open year round width permanent due to jetties | + | + | + |
| Big River | Open year round | + | + | + |
| Albion River | Open year round | + | + | +(minor) |
| Navarro River | Open year round (nearly closes) | + | + | + |
| Garcia River | Open year round | + | + | + |
| Gualala River | Intermittently Open | + | + | + |
| | (Central California) | | | |
| Russian River | Open year round | + | + | + |
| Salmon Creek | Intermittently Open | + | - | minor |
| Bodega Bay | Open year round constant width maintained by jetties | + | + | - |
| Estero Americano | Intermittently Open | + | + | - |
| Estero San Antonio | Intermittently Open | + | + | - |
| Tomales Bay | Open year round | + | + | + |
| Abbotts Lagoon | Intermittently Open | + | - | - |

TABLE III.C.2.b.(7)-1 (Con't)
ESTUARIES OF ECOLOGICAL CONCERN IN NORTHERN AND CENTRAL CALIFORNIA

| Estuary | Opening to Sea | Bird Feeding Area (+) | Important Marine Fish Nursery Grounds (I) | Important Anadromous Fish Spawning Route |
|---|---|---|---|---|
| Drakes Estero/Limantour Estero | Open year round | + | + | +(minor) |
| Balinas Lagoon | Open year round | + | + | +(minor) |
| Rodeo Lagoon | Intermittently Open | + | - | +(minor) |
| San Francisco Bay complex | Open year round | + | + | + |
| San Gregoria Creek | Intermittently Open | + | - | +(minor) |
| Pescadero Creek | Intermittently Open | + | + | + |
| Gazos Creek (steelhead) | Intermittently Open (open most of year) | + | - | + |
| Scott Creek | Intermittently Open | + | - | +(minor) |
| Baldwin Creek Ponds | Intermittently Open | + | - | +(minor) |
| Corcoran Lagoon/Moran Lake | Intermittently Open | + | - | +(minor) |
| Wilder Creek Pond | Intermittently Open | + | - | + |
| San Lorenzo River | Open year round | + | - | + |

TABLE III.C.2.b.(7)-1 (Con't)
ESTUARIES OF ECOLOGICAL CONCERN IN NORTHERN AND CENTRAL CALIFORNIA

| Estuary | Opening to Sea | Bird Feeding Area (+) | Important Marine Fish Nursery Grounds (I) | Important Anadromous Fish Spawning Route |
|---|---|---|---|---|
| Watsonville Slough/Pajaro River | Open year round | + | - | + |
| Elkhorn Slough complex | Open year round constant width maintained by jetties | + | + | - |
| Salinas River | Intermittently Open | + | -(minor) | - |
| Carmel River | Intermittently Open | + | + | + |
| Little Sur River | Intermittently Open | + | + | (steelhead) + |
| Big Sur River | Intermittently Open | + | + | (steelhead) + |
| Morro Bay | Open year round constant width maintained by jetties | + | + | - |

other areas between the high tide mark and 1,000 feet below the low tide mark. ASBS are also designed to protect intertidal and shallow subtidal areas. They are areas containing biological communities of such extraordinary, even though unquantifiable value that no acceptable risk of change in their environments as a result of man's activities can be entertained.

In the Nothern California Planning area there are 2 ecological reserves, 1 marine life refuge, and 5 areas of special biolgical significance (ASBS) listed below.

AREAS OF DEFINED BIOLOGICAL SIGNIFICANCE IN NORTHERN CALIFORNIA ASBS -
AREA(S) OF SPECIAL BIOLOGICAL SIGNIFICANCE

| | |
|---|---|
| Redwoods National Park | ASBS |
| Trinidad Head Kelp Beds | ASBS |
| Kings Range National Conservation Area | ASBS |
| Pigmy Forest Ecological Staircase | ASBS |
| Kelp Beds at Saunders Reef | ASBS |

### (9) Marine Sanctuaries

At present, there are no marine sanctuaries in northern California.

## c. Socioeconomic Environment

### (1) Employment and Demographic Conditions

The Northern California Planning Area includes the counties of Del Norte, Humboldt, and Mendocino. These counties have the lowest population density of the counties in California's coastal zone. The planning area has approximately 1 percent of the State's population. This region's local economies depend largely on natural resources.

Lumbering has historically been the dominant industry in the northern coastal region. Other major industries are agriculture, tourism, and fishing. The continuing growth of tourism and recreation in the region has resulted in an increase in the importance of both the services and trade sectors of the local economy. The tendency of these industries to be cyclical over time and highly seasonal in nature pose a problem. Employment is low during the rainy season when activity is curtailed. This is reflected by the wide variations in the unemployment rate in the area.

### (2) Coastal Land Uses and Water Services

The California Coastal zone is 1,100 miles long and varies from five miles wide in rural areas to 1,000 feet wide in urban areas. Land use planning within the California coastal zone is hierarchical in structure. The California Coastal Commission is responsible for developing general policy except for the San Francisco Bay Area. (The San Francisco Bay area is under the jurisdiction of the San Francisco Bay Conservation and

Development Commission.) Responsibility for actually developing the coastal land use plans is then delegated to each county. County coastal plans usually cover unincorporated communities. The development of coastal plans in incorporated communities is further delegated by the counties to the city governments. The California Coastal Commission retains supervision over this process. To date (September, 1985), the Commission has reviewed and acted upon 106 of the 123 coastal plans.

Of the three planning units covering California, Northern California is the most rural in character and it is sparsely populated. Land use is principally open space in support of the timber industry and tourism. The timber industry is by far the principal source of income for the people in this region. There is very little energy related development and hence very little land use devoted to energy development.

Approximately seventy percent of California's precipitation occurs in the northern third of the state. (This roughly corresponds to the MMS's northern California planning area). Water use, however, is just the reverse. More than eighty percent of the water used is used in the southern two thirds of the state. Total streamflow is abundant, but it is poorly distributed in place and time in order to meet need. Overall, available water supplies are considered sufficient to meet current needs according to the California Department of Water Resources. Part of this need, however, is being met by overdrafting groundwater supplies in central and southern California.

The treatment of waste water is a potentially significant issue. Continued population growth will result in increased competition for high quality water for direct human consumption, recreation, fisheries, wildlife habitat, agriculture, and industry. To obtain the maximum range of water, waste water reclamation will become increasingly important. Currently 2% of net water use is reclaimed water.

The large coastal urban areas generally have waste water treatment facilities. Many of the southern coastal communities do not and rely instead on simpler methods to treat waste water. Further, due to the absence of industrialization in the smaller communities, the communities are principally prepared to only process domestic waste water.

Northern California - Water availability is a seasonal issue. During the rainy season there is a sufficient supply of water. However, due to the lack of storage facilities, the availability of water tends to be a problem in late summer. Urban water use only accounted for 14% (1980) of net water use in the North Coast Hydrologic Study Area, California Department of Water Resources. The remaining 86% of water use was dedicated to irrigated agriculture, wildlife, and recreation. The urban shortage was identified at 1,000 acre feet, and no water was used in support of energy production.

Waste water treatment is accomplished by septic tanks and sewer lines in rural areas. As with water systems, sewage treatment systems are limited to urban areas, and most are near capacity. The cities Eureka, Crescent City, Mendocino, and Fort Bragg have outfalls into the ocean, but no water quality problems have been noted.

### (4) Commercial Fisheries

Roughly 12 percent of statewide landings, 25 percent of the catch, and 16 percent of the landed value of fisheries products are brought into northern California ports. This value is about $39 million, and applying a multiplier factor of 3.1 to include associated activities (U.S. Water Resources Council, 1977) results in the fisheries having a net value to the local economies of about $120 million. This amount has a much greater relative influence on the local economies of this region than do the fisheries of other coastal regions do to their economies. This is due to the recent, chronic, coast long depression of the timber industry and the sparsely populated, mostly rural nature of this region.

Major fisheries are for chinook and coho salmon, dungeness crab, rockfishes, sablefish (black cod), flatfishes (expecially dover and petrale sole), albacore tuna, Pacific Ocean shrimp, and giant Pacific oyster. Most fish are caught by trawling, except salmon, which are taken by trolling. Crabs and lobster are caught in pots, while oysters are harvested by hand. Major port cities are Crescent City, Eureka, and Fort Bragg. Minor ports include Klamath, Trinidad, Shelter Cove, and Albion.

Mariculture activities are common in the coastal region. Riverine salmon hatcheries are commonest, an attempt to replenish runs damaged by dam building, habitat degradation, flow diversion, and over fishing. Humboldt Bay is the maricultural center, with research and development or pioneer commercial ventures for salmon, other fin fish, clams, oysters, and others.

A more detailed discussion of the fishery can be found in Winzler and Kelley (1977).

### (4) Recreation and Tourism

The northern California coast is a highly sensitive natural resource area and is an important recreational asset to the residents of the State and to tourists. Along the coast, recreation is primarily water-dependent and water enhanced and encompasses both active participation, and aesthetic and passive aspects. There are numerous public and privatly owned recreational sites which have direct access to the ocean.

A complete listing of recreational sites is presented in POCS Technical Paper No. 81-5 (The Granville Corporation, 1981). Access sites have been listed and described for the California Coast by the Coastal Commission in the California Coastal Access Guide (1981).

These areas have a total shoreline of over 198.7 km (123.5 miles) which is more than 43.06 percent of the 461.5 km (286.8 miles) ocean shoreline of the North Coast. This, in turn, permits visitors access to the ocean with relative ease in order to pursue whatever activity they desire.

Water dependent marine recreation includes such activities as boating, fishing, surfing, swimming and diving. Each one of these recreational activities is dependent upon an accessible and unpolluted marine environment. Most of these activities occur in sole association with established shoreline park, recreation, beach and public access sites.

Other recreational activities closely associated with the coastal and offshore environment of northern California are water enhanced. The ocean provides a setting which enhances the enjoyment of such activities as beach use, sightseeing, picnicking, camping, golfing and off-road vehicle use. Like water dependent activities, most water enhanced recreational activities potentially affected by OCS exploration and development occur along the shorefront park, recreation, beach camping and public access sites. Seasonality and weather have a major temporal influence on the intensity and extensiveness of recreational activity.

The Granville Corporation (1981) assessed the economic value of recreational expenditures by residents of northern California. More important than economics is the social and welfare value of recreation to individual citizens.

Sportfishing is an important recreational activity throughout northern California. Six fishing methods are predominant in the northern California ocean sportfishery: shore, pier, skiff, party boat (commercial passenger fishing vessel), skin diving (including SCUBA), and surf netting. Shore and pier fishing are by far the most popular methods, receiving over 80 percent of the hook-and-line effort (Miller and Geibel, 1973). Fishing from boats takes place along the entire coast, however, it is concentrated in areas such as Humboldt Bay. The distribution of boating and the number for the California Coast are given in POCS Technical Paper No. 81-5 (Granville Corporation 1981).

Tourism is one of the major industries in California, and has been recognized as an important element in the regional economy.

Most of the coastal communities can be considered tourist centers, as they are economically dependent upon both transient and stationary tourism. Transient tourism is popular along the coast as can be seen by the number of tourists who drive along sections of the coastal highway. Stationary tourism is important in that the total expenditure of the tourist will be added to the local economy, and will also have a direct bearing on the sportfishing and recreation of the local area.

The overall value of tourism for the northern California Coast in 1979-1980 was estimated in values of $65 million.

The northern California coastline is an outstanding visual resource of great variety, grandeur, contrast and beauty, and contributes to the economic success of the tourist industry.

The systematic analysis of scenic quality is a complex and difficult task because of the great variety of natural and man-made conditions along the California coast. The Bureau of Land Management has developed a rating system that attempts to objectively rate, on a regional scale, the visual quality of the various landscapes on the California coastline.

The rating of the coastline, although subjective, does present the aesthetic quality of the coastline on a physiographic scale. This permits a relative aesthetic quality of the California coast to be obtained; however, the use and accessibility levels for each unit is not considered. The complete results of the study are given in POCS Technical Paper No. 81-5 (The Granville Corporation, 1981); however, the values given in the study should not be taken as absolute, but should be used to show the relative trend of the asesthetic value of the coastline.

Accessibility of the areas tend to be less, or virtually nonexistent, for the more pristine areas such as the King's Range, and thus, these areas tended to have less use than the more developed and easily accessible areas.

### (5) Cultural Resources

The coastal lands contain numerous archaeological sites, most of which represent Native American resources. In 1977 there were a total of 504 known archaeological sites in the coastal counties of northern California. The heavier concentration of sites recorded in some counties is partially a reflection of large indigenous populations and mainly the result of the degree and intensity of surveying.

In addition to the prehistoric sites, there are over 234 historic sites in the coastal counties, many of which are in the National Register of Historic Places and/or on the California State Register. There are presently about 5,000 Native American residents in the northern coastal counties, although many are from other areas and States. There are numerous geographic landmarks and areas that are of special concern to Native Americans because they were traditionally used by their ancestors. Ceremonial and subsistence gathering continues today both inland and on the coast, with the intertidal zone being especially important to coastal dwellers. Although not well documented, family-gathered foodstuffs account for up to 25 percent of total subsistence for some Native American families. Traditional medicines, herbs, and teas are also gathered. It is not certain when the California Coast was first occupied because worldwide sea level changes (eustatic variation) may have submerged the archaelogical remains of those early coastal dwellers. At the present time, sea level is approximately 120 m above the sea level of 40,000 B.P. The offshore region of California is believed to contain numerous cultural resources.

Over 470 shipwrecks of historic interest have been reported along the coast of northern California. Most of the offshore losses have been reported in State, rather than in Federal, waters. Though the locations of historic shipwrecks have been in some cases precisely noted, they are often far, perhaps many miles from the location of their reported loss. Location errors have occurred because of navigational error, loss report error, or vessel drift.

### (6) Marine Vessel Traffic

There are currently no established or proposed shipping lanes along the coast of California north of San Francisco. The general vessel traffic parallels the coast, maintaining a distance offshore of several miles. The tankers carrying Alaskan crude oil (from TAPS) maintain a distance well offshore until coming into port. (Walker, personal communication, 10/22/84). There are no major ports or any "Port Access Zones" along the California Coast north of San Francisco. Inquiries by the U.S. Coast Guard, however, were made to determine how closely ships pass to major headlands. The percentages were: 0-5 miles 27%, 6-10 miles-36%, 11-15 miles-17%, 16+ miles-20% (Federal Register, Volume 47, No. 199, October 14, 1982). See Table III.C.2.c.(6)-1 for data on port activity levels.

Table III.C.2.c.(6)-1

Marine Vessel Traffic - Ports of Northern California

Source: U.S. Department of the Army, Corps of Engineers. Waterborne Commerce of the United States, Calendar Year 1982, Part 4. July, 1984.

| | Total Number of Vessel Trips (includes self and non-self propelled, excludes domestic fishing craft) | | |
|---|---|---|---|
| Port | Inbound | Outbound | Total Freight Traffic (Short Tons) |
| Humboldt Harbor and Bay | 254 | 249 | 873,041 |
| Crescent City Harbor | 55 | 46 | 98,283 |

### (7) Military Uses

Military activity along the northern California coast primarily involves the Navy and Air Force. Activities include: all weather flight training, submarine transitting and anti-submarine warfare training. Most of the offshore activity begins at least 6 - 15 miles offshore, leaving a fairly wide margin for nonmilitary activity closer to shore. However, the Anchor Bay Military Operating Area starts onshore and extends offshore to the 3-mile line between just north of Pt. Arena to Fort Ross.

### (8) Native Subsistence

(See discussion in Section III.C.1.c(8) and III.C.4.c.(8)).

## 3. Central California

### a. Physical Environment

#### (1) Geology

The northern portion of the Santa Maria offshore basin (sometimes referred to as the "Partington basin," the Ano Nuevo (Outer Santa Cruz) basin, the La Honda (Inner Santa Cruz) basin and the Bodega basin are located within the planning area. See Section III.C.2.a.(1) for a discussion on the tectonic history of central California.

The Ano Nuevo basin is a small Neogene basin extending northwest from the Monterey Peninsula to the base of the continental slope west of the Farallon High (see Figure III.C.2.a.(2)-2). The basin is approximately 75 mi (120 km) long and 21 mi (35 km) wide.

The onshore La Honda basin extends northwest from east of Monterey Bay to the coast at Half Moon Bay, south of San Francisco. The basin possibly extends offshore to the northwest across the Seal Cove-San Gregorio fault zone. The basin is approximately 90 mi (145 km) in length and 12 mi (20 km) in width. The Bodega basin may be an extension of the La Honda basin, but much of the Upper Paleogene sediments present in the onshore La Honda basin are not present in the outcrops and wells in the Point Reyes/Bodega area. The basin is about 110 mi (180 km) long and averages 15 mi (25 km) in width.

#### (2) Geologic Hazards

Potential geologic hazards for portions of central California offshore basins have been described prior to OCS Lease Sale No. 53 (McCulloch and others, 1977; McCulloch and others, 1980; Fields and others, 1980; Richmond and others, 1981) and OCS Lease Sale No. 73 (McCulloch, 1980; McCulloch and others, 1982). These studies describe the types of potential geologic hazards that may occur on the continental shelf and slope offshore central California.

Potential geologic hazards identified offshore California are seismicity, active faults, mass transport of sediments, steep slopes and canyon walls, buried channels, hydrocarbon seeps and shallow gas accumulations. Also see Section III.C.2.a.(2) for a discussion of geologic hazards for northern California.

##### (a) Seismicity

Central California is located within the circum-Pacific volcanic and seismic belt, which has been active throughout middle and late Cenzoic time (Hamilton and others, 1969). Earthquakes of magnitude 5 and greater have been recorded from Monterey to San Francisco.

##### (b) Faults

The San Andreas fault extends northwest along the entire central California coast to Cape Mendocino where it bends westward and extends offshore to merge with the Mendocino fracture zone. Maximum probable earthquake in this area is estimated to be magnitude 8.3 (Greensfelder, 1974; Smith, 1975).

The active San Gregorio-Palo Colorado fault zone, which forms the eastern boundary of the Ano Nuevo basin, has a maximum probable earthquake occurrence estimated to be magnitude 6.5-7.0 (Greensfelder, 1974; Slosson and Associates, 1978). The Seal Cove fault zone along the southeast border of Bodega basin, and the Pilarcitos fault, forming the southeast boundary of the La Honda basin, are both considered potentially active (Cooper, 1973).

### (c) Mass Tansport

Evidence of slope failure and the mass transport of surficial sediments is common on the continental slope west of the Bodega basin and in the submarine canyons located in the planning area (McCulloch and others, 1980; Richmond and others, 1981).

### (d) Slopes

Moderate (5°) to steep slopes (greater than 10°) occur along the continental slope off central California, on the flanks of the major bedrock highs, and locally within the many submarine canyon systems. Buried channels are also found in submarine canyon systems and fans.

### (e) Hydrocarbon Seeps

Water-column anomalies on high-resolution seismic profiles, indicating possible hydrocarbon seeps offshore central California, occurred exclusively on the shelf and upper slope in water depths less than 705 ft. (215 m) (Richmond and Burdick, 1981).

### (f) Shallow Gas

In the central California planning area, high pressure shallow gas accumulations occur in deformed sediments associated with fault zones and anticlines and in undeformed seaward dipping unconsolidated or semi-consolidated sediments at the shelf break.

### (3) Non-Petroleum Mineral Resources

Heavy mineral concentrations along the California coast are limited in extent and volume. A description of the heavy mineral concentrations along the central California coast can be found in Phillips (1979). (Also see Section III.C.2.a.(b).) Most of the deposits occur on the present beaches.

Investigations of the nearshore shelf near Point Reyes (McCampbell, 1969) record isolated gold occurrences in the surficial sediments. The gold was thought to be derived from the ancestral Sacramento River, but was probably derived from erosion of adjacent granitic rocks on Point Reyes, which contain trace amounts of gold.

### (4) Oceanography

#### (a) Chemical

The chemical oceanography of the central California planning area is quite similar to that of northern California with the exception that the run-off is lower in this region.

The California current (surface) is relatively rich in oxygen while the undercurrent at about 200 m is relatively poor (Reid, 1965). Water nearer the bottom offshore has somewhat higher oxygen content than that of the Counter current. Nutrient concentration in this area as well as to the north is strongly influenced by upwelling, and utilization by phytoplankton. There is not sufficient observational data available upon which to base any distinction of the central California planning area from those to the north.

#### (b) Physical

Hydrographic Conditions: The Central California Planning Area lies between San Luis Obispo County and Mendocino County. This stretch of coast includes San Francisco and Monterey Bays. According to Dodimead, et al. this region is primarily influenced by the Transitional Domain, the large river runoff (except for San Francisco Bay outflow) and precipitation seen along the coast north of this area and which contribute to the coastal domain conditions, do not exist in this planning area. The maximum sea surface temperature of 14°C to 15°C occurs in early fall (Robinson, 1976). In summer, upwelling can occur very strongly over this region, especially north of Bodega Bay. The conditions are reviewed in detail in Winzler and Kelly, 1977.

Large scale circulation: As with the other planning areas, the large scale circulation in this planning area is dominated by the California Current System. The coastal circulation in the planning area south of San Francisco has been extensively studied in the Central California Coastal Circulation Study (CCCCS), funded by MMS (the final report is due in 1986). The region between Bodega Bay and Point Arena has been studied extensively by the CODE Project funded by NSF.

Chelton (1984), using long-term records of density to estimate geostrophic flow (relative to the 500 db surface) across two sections perpendicular to the central California coast, found that flow in the upper 100 m was southward from February to September and northward from October to January. This is a somewhat surprising result, because as Chelton points out, this poleward long-term average geostrophic surface current in fall and early winter is in opposition to the overlying long-term average wind stress. He also found that for geostrophic flow deeper than 100 m, there were distinct differences between that seen off Point Conception and that off Point Sur. Off Point Conception, the deeper geostrophic flow was northward all year with maxima in December and June.

However, off Point Sur the deeper flow appears to have a maximum northward flow in December and a weak southward flow from March to May. This would result in an offshore flow at depth somewhere between these two locations. Preliminary analysis of current meter records from the CCCCS support this finding.

Factors Influencing Circulation: The primary forcing of the circulation in the Central California Planning Area is the local and remote wind field. Upwelling favorable winds occur along this stretch of the California coast between June and October. They are episodic in magnitude, with episodes of high winds lasting on the order of ten days. These episodes are separated by periods of weak or calm winds. Wind relaxations have been associated with current reversals or "relaxation events" in which the flow at the surface can abruptly change from weakly toward the south to strongly toward the north (Davis 1985; Tait, personal communication).

Modes of Variability: The central California Planning Area is influenced by essentially the same modes of variability as are seen in the northern California Planning Area. The seasonal variability has been discussed above.

The variability seen in the California Current System on an interannual basis is at least as large as the annual cycle. Although few direct current meter observations in this region were available prior to the Central California Coastal Circulation Study, the CalCOFI measurements of temperature and salinity represent the best (longest) available time series of the density field.

The short-term variability in this region is similar to that in the northern California planning area.

### (5) Water Quality

Water quality off the coast of central California is generally very good, but some areas near population centers are polluted (Miller and McGrew 1977). Poor water quality is found throughout San Francisco Bay Where metals, hydrocarhons, high levels of coliform bacteria and low dissolved oxygen are prevalent. Sewage effluent has measurably degraded parts of Monterey Bay. Results of the "mussel watch" program (Stephenson, Martin and Martin (1978), which evaluates toxicant conentrations in Mytilus sp. along the entire California coast indicate that the cleanest coastal waters occur north of San Francisco and south of Monterey Bay. Water quality parameters along the central California coastline are also affected by a natural phenomenon during the summer months; upwelling, driven by stong northerly winds, results in lower dissolved oxygen and higher nutrients and carbon dioxide concentrations as deeper, cooler water is advected vertically into shallow depths. Besides the municipal and industrial activities that are associated with the major coastal cities, water quality is affected to a minor degree by runoff from agricultural lands and rivers, aerial fallout, harbor discharges, thermal discharges, and materials from boats and ships.

### (6) Ocean Dumping

Off the coast of central California, there are 33 designated historic and active dump sites (See Table IV.B.9.a.(1)(d) and Figure III.C.3.a.(6)-1). The materials dumped at each of these sites varies as stated in Section III.C.2.a.(6).

In central California waters, there are 6 active dredge spoil sites. Four of these sites are in State waters with three in San Francisco Bay, and one off Moss Landing. The two sites on the Federal OCS are: one at the San Francisco Bar and one off the Farallon Islands. There are three designated radioactive dump site off central California, all on the Federal OCS. The three sites are situated southwest of the Farallon Islands in 500, 850 and 1,200 fathoms of water. These sites are large in area with the Farallon Island sites covering a total area in excess of 200 square miles. Of the 33 sites off central California, 12 are within 3 nm of land with the remaining 21 sites on the Federal OCS.

### (7) Climate

The climate of the central California coastal area is marine in character with cool, dry summers and mild, wet winters. The area is primarily dominated by the North Pacific Subtropical High pressure system. The Pacific High is most dominant in the summer when it is located to the west and north of California and reaches its greatest intensity and size. This results in dry, stable weather which prevails from May through September. In the fall, the high pressure system starts to weaken and migrates southward. Pacific storm systems frequently pass through the area in winter bringing periodic cloudiness and precipitation. Almost all of the annual rainfall occurs in the period of October through April.

Winds are primarily from northwesterly directions. Average wind speeds range from 10 to 20 knots (nautical miles per hour), with winds generally increasing from south to north.

Temperature inversions (conditions in the atmosphere where temperatures increase with height) occur frequently along the California coast, particularly in the summer season. This results in limited vertical dispersion of air pollutants. However, horizontal dispersion of air pollutants is often favored by the fairly strong winds that frequently blow in the coastal areas.

### (8) Air Quality

Air quality in most of the coastal areas of central California is generally good. Ozone concentrations exceed the national ambient air quality standard (0.12 ppm) in the San Francisco Bay area. Ozone is generated by photochemical reactions involving nitrogen oxide and hydrocarbon pollutants, and is almost primarily a summertime phenomenon. Total suspended particulate concentrations do not exceed national ambient air quality standards. However, the California ambient standard is exceeded at many locations in all air basins. Concentrations of nitrogen

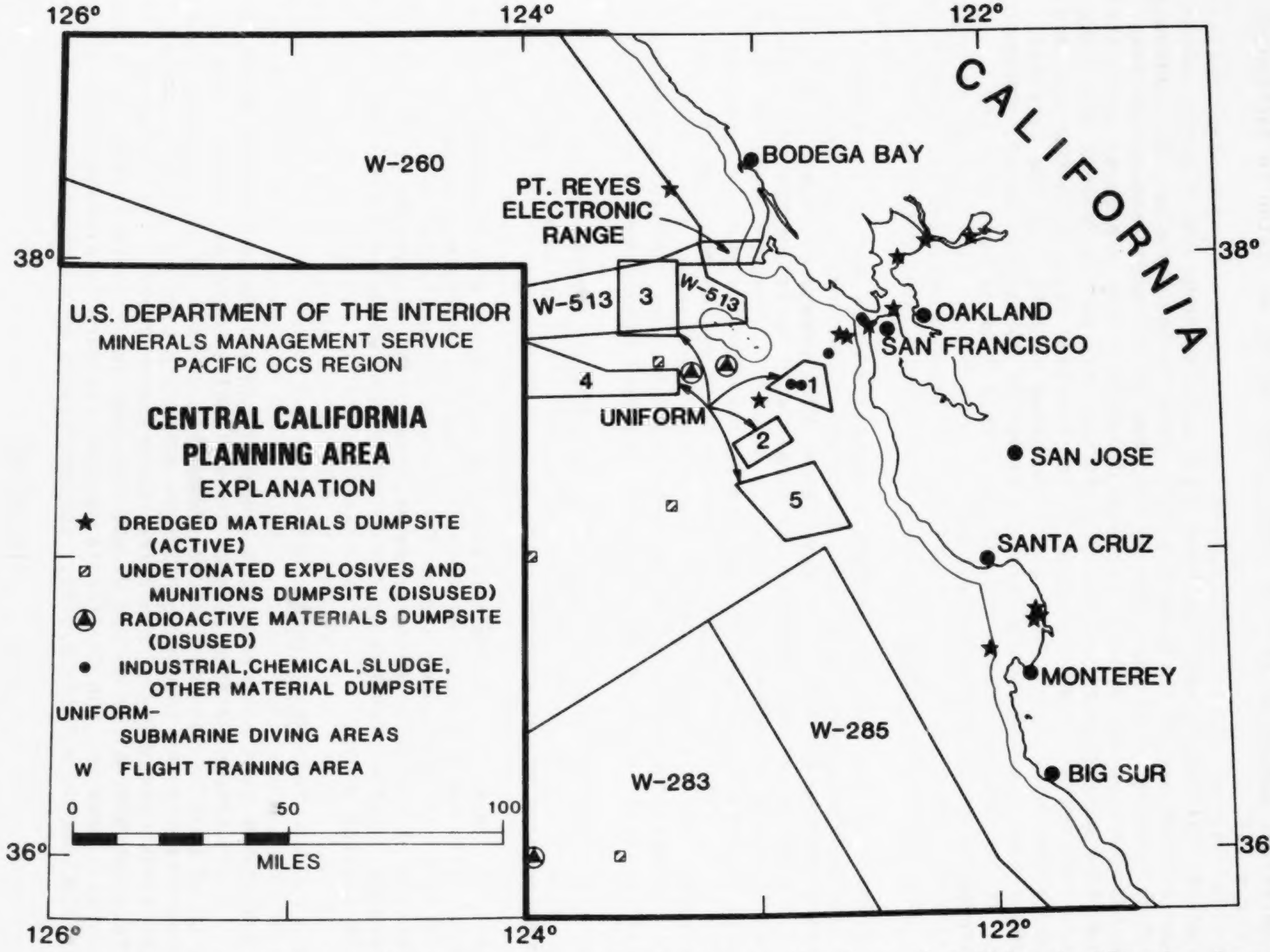
126°
124°
122°
38°
36°
CALIFORNIA
W-260
PT. REYES ELECTRONIC RANGE
BODEGA BAY
OAKLAND
SAN FRANCISCO
SAN JOSE
SANTA CRUZ
MONTEREY
BIG SUR
W-513
W-513
1
2
3
4
5
UNIFORM
W-285
W-283
U.S. DEPARTMENT OF THE INTERIOR
MINERALS MANAGEMENT SERVICE
PACIFIC OCS REGION
CENTRAL CALIFORNIA PLANNING AREA
EXPLANATION
★ DREDGED MATERIALS DUMPSITE (ACTIVE)
▨ UNDETONATED EXPLOSIVES AND MUNITIONS DUMPSITE (DISUSED)
Ⓐ RADIOACTIVE MATERIALS DUMPSITE (DISUSED)
● INDUSTRIAL,CHEMICAL,SLUDGE, OTHER MATERIAL DUMPSITE
UNIFORM- SUBMARINE DIVING AREAS
W FLIGHT TRAINING AREA
0
50
100
MILES

Figure III.C.3.a.(6)-1. Military Areas and Dumpsites in the Central California Planning Area.

dioxide, carbon monoxide, and sulfur dioxide are below ambient standards in all areas.

b. Biological Environment

(1) Plankton (See discussion of plankton for Washington and Oregon planning area and Southern California Planning area).

(2) Benthos

(a) Intertidal Benthos

The relative amount of shore type of central California is approximately 60 to 65 percent rocky intertidal and 35 to 40 percent sandy beach.

(i) Rocky Intertidal Scientific literature on rocky intertidal communities in central California is spotty with a few areas, particularly the Pacific Grove area near Monterey, very well studied. Much of the rest of the coast has not been systematically studied. Woodward and Clyde (1982), however, has surveyed the entire area from helicopter.

The planning area is within the Oregonian biogeographical province which begins at Pt. Conception and extends to Puget Sound, Washington or Prince William Sound, Canada depending on the author (Valentine, 1966). Literature on rocky intertidal species distribution indicates that the change in species composition and species distribution in central California is not major (Stephenson and Stephenson, 1972). (Woodward and Clyde, 1982). The Minerals Management Service (1983) has listed the sensitive rocky intertidal areas of northern and central California (Table III.C.3.b.(2)-1).

(ii) Sandy Intertidal

Because of the continued restructuring of sandy beaches, the number of individuals per species varies greatly from year to year. There is, however, a characteristic group of animals which live just below the low tide line or within the sand

between the tide lines. A few organisms even live higher up on the beach in burrows or beneath organic debris. Additional general comments on sandy beach ecology are listed under northern California.

Two species of recreational and economic importance, the razor clam Siliqua patula, typical of the region, and the pismo clam Tivela stultorum, should be mentioned as important members of this habitat.

(b) Subtidal Benthos

The continental shelf of central California is similar to that of northern California and is essentially the same as described in that section.

## TABLE III.C.3.b.(2)-1

## SENSITIVE ROCKY INTERTIDAL AREAS OF CENTRAL CALIFORNIA BASED ON ISOLATION, FLAT PLATFORMS AND DISTANCE OF CONTINUOUS HABITAT WITHOUT SIGNIFICANT INTERRUPTION

(1) Point St. George, Pebble Beach -
Heavy concentration of stocks ranging in size from one meter diameter to actual vegetation supporting island, one supporting a tree. Also isolated north and south from other rocky intertidal areas by sandy beaches.

(2) Patricks Point to Trinidad Head ASBS -
A lot fo surface area available for communities, although communities not exceptionally rich. Also isolated north and south from other rock intertidal areas by sandy beaches.

(3) Rockport to Westport -
Certain areas between these towns have broad flat rocky platforms.

(4) Fort Bragg to Fort Ross -
Within this stretch of coast are extremely convoluted rocky shores having broad flat intertidal platforms. The most outstanding of these areas of secondary concern are listed as follows:

- Just north of Fort Bragg
- Soldier Point Area
- Hare Creek Bay
- Casper Point
- Point Cabrillo
- Mendocino Bay to Van Damm Beach
- Arena Cove
- Saunders Landing (and Reef) to Iverson's Point
- Robinson Point
- Gualala Point to Black Point off Sea Ranch (include Gerstle Cove ASBS)
- North West Cape

(5) Mussel Point to Bodega Head -
Extensive numerous flat intertidal platforms. Isolated north and south from other rocky intertidal areas by sandy beaches.

(6) Point Reyes Headlands -
Very abundant flora and fauna, particularly dense mollusk populations.

(7) Agate Beach and Duxbury Reef -
Largest flat intertidal reef in California with some isolation north and south from other rocky intertidal areas. Giant mussel populations.

(8) Farallon Islands -
Rocky area isolated from other rocky intertidal areas by approximately 15 miles.

Table III.C.3.b.(2)-1 continued

(9) James Fitzgerald Marine Reserve through Piller Point -
Broad flat rocky platforms. Highly productive intertidal stretch of coast extending for 5 miles. Similar assemblages to Duxbury Reef.

(10) Ano Nuevo Island -
Extensive flat intertidal platforms.

(11) Monterey Peninsula -
Has 80% of known flora of the western coast of North America. Is a major biogeographic transition zone. High density of invertebrates, including mollusks. Summer fog prevents dessication to organisms at low tide. Historic scientific area. Includes areas semi-protected from large Pacific waves (Pebble Beach).

Flat intertidal platforms on Monterey Peninsula include:

Table Rock Area -
and
Needle Rock Point -

Pacific Grove Marine Gardens ASBS -
Important intertidal area; one of the best studied in the country, partly because of its great diversity of species and richness.

Cypress Point -
and
Point Pinos -
Along 17 Mile Drive, Monterey Peninsula, the two areas which stand out, having the broadest flat rocky platforms along a stretch of coast, and having a relatively continuous rocky intertidal with scattered flat platforms.

(12) Carmel River State Beach to Soberanes Point (including Point Lobos Reserve) -

Many deep coves giving a lot of surface area to intertidal habitats. Several semi-protected areas including Whaler's cove. Only rich population of intertidal macroalgea Eisenia in central-northern California (Point Lobos Reserve).

(13) Piedras Blancas Point Area -
Flat intertidal platforms.

(14) Cayucos to San Simeon Beach -
Very rich intertidal communities and diverse habitats, including intertidal pools, sea stacks, boulder beaches. Includes broad flat intertidal area at San Simeon Point which is somewhat isolated to the north and south by sand beaches and is very diverse in chitons and barnacles.

(15) North of Spooner Cover to Point San Luis -
Numerous intertidal black abalone, limpets, chitons and nudibranchs. Flat intertidal platforms, including a very extensive one just north of Spooner Cove which is isolated from other rocky intertidal areas to the north by large sandy beach (Morro Bay spit).

Table III.C.3.b.(2)-1 continued

(16) Pirate's Cove Area - Fossil Point to Mallough Landing (Avila) -
Numerous flat intertidal platforms. Numerous intertidal black abalone, chitons and nudibranchs.

(17) Mussel Point to Point Sal -
Low flat intertidal platforms. Isolated north and south from other rocky intertidal areas by sandy beaches. Numerous intertidal black abalone, limpets, chitons and nudibranchs.

(18) Packard Point to Purisimo Point off Vandenburg Air Force Base -
Numerous flat platforms. Isolated north and south from other rocky intertidal areas by sandy beaches.

(19) Point Arguello to Cojo Point in Southern California, including Point Conception -
Dividing line between major biological provinces and consisting of both northern (Oregonian) and southern (California) species.

Central California has important kelp forests which gradually decrease in northern California.

The subtidal benthic communities and assemblages of central California are not well known. A comprehensive literature survey by Winzler and Kelly Consulting Engineers (1977) summarized previous benthic studies in the Central and Northern California region. Other studies have been conducted and include Allen (1964), Hardy (1972), Johnson (1971) and Odemar, et al., (1968); however, most of these are relatively localized in scope and tend to focus on areas close to shore.

### (3) Fish

Roughly 500 species of fish have been recorded in this planning area (Miller and Lea, 1972 and Winzler and Kelley, 1977). The continental shelf is narrow through the region, sometimes as little as 2 km (1.25 mi) wide. It does not contain large offshore islands, banks, or basins. The Farallon Islands are very small compared to the southern California Channel Islands, and don't offer much submarine habitat diversity. However, the narrowness of the shelf and the occurrence of several offshore submarine canyons, as well as the continental slope relief, bring the deeper residing fauna close to shore.

The major shoreline feature of this region is the large number of extensive inshore bays and estuaries (Bodega Bay, Drakes Bay, Tomales Bay, the San Francisco-San Pablo Bay and Sacramento River delta complex, Monterey Bay, and Morro Bay). These areas provide enormous areas of salinity and temperature (and hence density) gradients, nutrient inflows, and spawning and nursery grounds for many offshore fish species (herring, salmon, sturgeon, striped bass, sharks, etc.).

Surface water temperatures are warmer here than they are farther north, but still significantly cooler than off southern California. Significant areas of upwelling bring colder bottom water and associated nutrients to the surface.

Common epipelagic fish species in this region include the northern anchovy, Pacific herring, Pacific sardine, chinook and coho salmon, albacore tuna, and market (opalescent) squid (a mollusc, but a large, free-swimming member of the nekton). Epipelagic fishes are often found in the deep-sea depths, and deepsea fishes are often found in the epipelagic zone, off central California.

Fishes commonly associated with sandy, shallow benthic environments include surfperches, flatfishes, sharks, skates, rays, croakers, and several of the epipelagic species. Rocky shallow benthic areas are commonly inhabited by sharks, greenlings, sculpins, rockfishes, sea basses, various eels, and gobies. Offshore benthic areas support sharks, sablefish, lingcod, rockfishes, and flatfishes. Information on specific fishes can be found in Horn (1977a, 1977b), BLM (1978, 1979, 1981), and MMS (1983). See Table III.C.3.b.(3)-1 for a list of representative fishes and their habitats for central California.

Table III.C.3.b.(3)-1

## REPRESENTATIVE FISHES AND THEIR HABITATS, CENTRAL CALIFORNIA

| Species | Habitat | | | |
|---|---|---|---|---|
| | Epipelagic | Benthic | | |
| | | Shallow | | Offshore |
| | | Sandy | Rocky | |
| Pacific lamprey | X | | | |
| Common thresher | X | | | |
| Pacific electric ray | | X | | X |
| Big skate | | X | | |
| Green sturgeon | | X | | X |
| Pacific herring | X | | | |
| Pacific sardine | X | | | |
| American shad | X | | | |
| Northern anchovy | X | | | |
| Salmon & steelhead (3 spp) | X | | | |
| Surfsmelt | X | X | | |
| Longfin smelt | | X | | |
| Northern clingfish | | | X | |
| Pacific hake | X | | | X |
| Pacific cod | X | | | X |
| Pacific saury | X | | | |
| Rockfishes (sev spp) | | | X | X |
| Sablefish | X | | | X |
| Lingcod/greenlings(sev spp) | X | | | X |
| Cabezon | | | X | |
| Striped bass | X | | | |
| Jack mackerel | X | | | |
| White croaker | | X | | |
| Surfperches (sev spp) | | X | | |
| Wolf eel | | | X | |
| Monkeyfaced-eel | | | X | |
| Pacific mackerel | X | | | |
| Albacore tuna | X | | | |
| California halibut | | x | | x |
| Curlfin turbot (sole) | | X | | X |
| Sand sole | | X | | X |
| English sole | | X | | X |
| Rex sole | | X | | X |
| Dover sole | | X | | X |
| Petrale sole | | X | | X |

### (4) Marine Mammals

Species and distribution are discussed under the northern California planning area. In addition, during the Center for Coastal Marine Studies (1983) surveys, California sea lions were most abundant in coastal waters south of their hauling grounds on Ano Nuevo Island and the Farallones, while sea otters were especially concentrated close to shore near Point Buchon, between Point Cayucos and Point Piedras Blancas, from Pfeiffer Point to Monterey, and in Soquel Cove in northern Monterey Bay. Details on endangered species are tabulated in III.B.2.b.(6).

### (5) Seabirds

Species and distributions are discussed in Section III.C.2.b.(5). The greatest offshore concentrations in the central California planning area occur from Monterey Bay to Bodega and south of Pt. Buchon. The most important nesting colonies are at Pt. Reyes and the Farallon Islands.

### (6) Endangered and Threatened Species

The central California planning area is utilized by several State and Federally listed threatened and endangered species which may be affected by proposed offshore lease sales and development. Those species most commonly listed for the central California area include seven endangered whale species, three endangered and one threatened species of turtle, the threatened southern sea otter, the endangered California Brown Pelican, American Peregrine Falcon, the Bald Eagle, California Least Tern and California clapper rail.

See Table III.C.2.b.(6)-1 for a more detailed listing of species and their distribution.

### (7) Estuaries and Wetlands

Estuaries are very important to the continental shelf ecology in central California, serving as spawning or nursery grounds for marine fish and invertebrates, habitat for many oceanic birds, and as supplies of nutrients to the near shore environment.

Although there are fewer estuaries in central California than in northern California, several very important estuaries are included in the area, including the largest estuary in the state, San Francisco Bay.

Criteria for the inclusion of estuaries on this list were major anadromous fish streams (California Fish and Game, 1973) and the Jones and Stokes (1980) tables labeled Areas of Ecological Concern (Volume IV Watersheds and Basins).

Important references concerning estuaries of central and northern California are the Summary of Knowledge report by Winzler and Kelly (1977), and the characterization report by Jones and Stokes (1980). Estuaries are also covered by U.S. Department of the Interior (1978a, 1979, 1980).

Individual estuaries have been given detailed coverage by California Fish and Game (CFS) as part of their wetland series as follows:

Balinas Lagoon (1970) Elkhorn Slough (1972) Morro Bay (1974a) Bodega Harbor (1975a)

### (8) Areas of Special Concern

There are four types of designated areas of special concern which are of biological importance. They are: 1) ecological reserves, 2) marine life refuges, 3) Reserves, and 4) area(s) of special biological significance (ASBS) controlled by the State of California . Ecological reserves and marine life refuges are very similar; however, there are more restrictions and controls in an ecological reserve. The purpose of the refuges and reserves is to reduce the abuse and waste of the State's tidepool resources by restricting general collecting of all animals living in tide pools and other areas between the high tide mark and 1,000 feet below the low tide mark. Additionally, the California Sea Otter Marine Life Refuge in Central California was established to protect the sea otter population throughout its range in California. ASBS are also designed to protect intertidal and shallow subtidal areas. They are areas containing biological communities of such extraordinary, even though unquantifiable value that no acceptable risk of change in their environments as a result of man's activities can be entertained.

In central California, there are 5 ecological reserves, 4 marine life refuges, and 15 areas of special biolgical significance (ASBS), (Table III.C.3.b.(8)-1).

(9) Marine Sanctuaries At present, one marine sanctuary exists in central California. The Pt. Reyes/ Farallon Islands Marine Sanctuary contains the largest breeding colony of seabirds in California and is an important pinniped rookery. The waters of the area are highly productive and are an important foraging area for the birds and pinnipeds. See Sections III.B.4, 5 and 6 FEIS Sale No. 73, 1983 for further detailed discussion on birds and pinnipeds.

The boundaries of the marine sanctuary are officially defined as follows:

> "The Sanctuary consists of an area of the waters adjacent to the coast of California north and south of the Reyes Headlands, between Bodega Head and Rocky Pt. and the Farallon Islands (including Noonday Rock), and includes approximately 948 square nautical miles.
>
> The shoreward boundary follows the mean high tide line and the seaward limit of Pt. Reyes National Seashore. Between Bodega Head and Pt. Reyes Headlands, the Sanctuary also includes the waters within 12 nmi of the Farallon Islands, and between the Islands and the mainland form Pt. Reyes Headlands to Rocky Point. The Sanctuary includes Bodega Bay, but not Bodega Harbor."

Oil development activities are not allowed in the Pt. Reyes/Farallon Islands Marine Sanctuary.

## TABLE III.C.3.b.(8)-1

## AREAS OF DEFINED BIOLOGICAL SIGNIFICANCE IN CENTRAL CALIFORNIA ASBS - AREA(S) OF SPECIAL BIOLOGICAL SIGNIFICANCE

| | |
|---|---|
| Del Mar Landing Ecological Reserve | ASBS |
| Gerstle Cove Reserve | ASBS |
| Bodega Marine Life Refuge | ASBS |
| Farallon Island | ASBS |
| Point Reyes Headland Reserve | ASBS |
| Point Reyes National Wilderness Area | ASBS |
| Bird Rock | ASBS |
| Double Point | ASBS |
| Duxbury Reef Reserve | ASBS |
| James V. Fitzgerald Marine Reserve | ASBS |
| Ano Nuevo Point and Island | ASBS |
| Elkhorn Slough Federal Estuarine Sanctuary | |
| Pacific Grove Marine Gardens Fish Refuge and Hopkins Marine Life Refuge | ASBS |
| Carmel Bay | ASBS |
| Point Lobos Ecological Reserve | ASBS |
| Julia Pfeiffer Burns Underwater Park | ASBS |
| Ocean Area Surrounding the Mouth of Salmon Creek | ASBS |
| Sea Otter Marine Life Refuge | ASBS |

Cordell Banks near San Francisco has been nominated as a possible marine sanctuary, but no decision has been made concerning its eventual incorporation into the marine sanctuary system.

An active candidate for a marine sanctuary is Monterey Bay and surrounding waters. The boundaries on this proposed sanctuary are still being discussed (Ralph Lopez, personal communication). Monterey Bay is proposed because of the rich bottom areas highlighted by a submarine canyon.

### c. Socioeconomic Environment

#### (1) Employment and Demographic Conditions

The central California planning area is composed of eleven counties (six coastal and five inland) ranging from San Francisco to the highly urbanized areas circling San Francisco Bay.

The planning area includes the coastal counties of Sonoma, Marin, San Francisco, San Mateo, Santa Cruz, and Monterey. The inland counties of Solano, Napa, Contra Costa, Alameda and Santa Clara are included because of the regional and economic integration of the area. These nine counties share extensive transportation facilities including ports, railroads, a network of freeways, and rapid transit lines, thus, securing the region's economic unity. This populous region is highly developed and diversified, and has approximately 23.9 percent of the state's population.

#### (2) Coastal Land Uses and Water Services

Central California can be principally characterized as rural except for the San Francisco Bay area. Large portions of the region are devoted to agriculture, natural resouce exploitation, and recreation. North of San Francisco, the dominant industries and hence land use, are: timber harvesting, agriculture, fishing and recreation. South of San Francisco, agriculture, recreation and fishing dominate the ecomonmy and land use. The San Francisco area is a large urban center with a full mix of urban uses along the bay and the peninsula. Many of the land areas long the coast of central California are protected from development (to various degrees) by Federal, State, or Local government ownership. Except for San Francisco there is little energy related development in the Coastal zone.

Unlike northern California, the supply of water has been stabilized by importing 57% of the water used. Eighty percent of the water used is for urban uses due to greater urbanization. Energy production accounted for 0.5% of water use. Since there is no offshore oil production in this region, this water is used to only support on shore production and refining of imported oil and gas. Only a nominal amount (0.6%) of net water use is met by overdrafting ground water. Santa Cruz County and Monterey County were not included in the above analysis as they are in a hydrologic study area which will be discussed under the Southern California planning area.

Overall, adequate capacity exists in the region to meet the demand for waste water treatment. Urban areas tend to have municipal treatment facilities. The rural areas tend to have less sophisticated sewage treatment facilities. Because of continued population growth, facilities in both rural and urban areas are under expansion, or have been expanded to meet current or projected population growth. If facilities could not be expanded, building moratoriums have been used to limit the generation of additional waste water. Marin County has just completed construction of a regional sewage treeatment facility to service its area.

To improve the water quality along the coast the California Water Quality Control Board is encouraging the construction of Deep Water Outfalls. The purpose of these outfalls is to move treated waste water away from the shoreline and to provide better dispersion of treated waste water. A clean water outfall is planned for San Francisco Bay to lessen discharges into the bay.

### (3) Commercial Fisheries

The central California area ports receive landings amounting to about 13 percent of the landings, 27 percent of the offshore catch, and 9 percent of the landings value, statewide. This amounts to about $22 million. Applying a multiplier factor of 3.1 (U.S. Water Resources Council, 1977) to include ancillary activities shows the economic value of the fisheries to be over $67 million. These major ports are Bodega Bay, Tomales Bay, Point Reyes, Sausalito, Richmond, Berkeley, Oakland, San Francisco, Princeton, Moss Landing, Santa Cruz, and Monterey. Important fisheries include the northern anchovy, white croaker, flounder, Pacific herring, lingcod, jack mackeral, rockfishes, sablefish, salmons, sanddabs, sharks and skates, soles, albacore tuna, dungeness crab, red abalone, giant Pacific oyster, and market squid. Trawling, trolling, longlining, traps, and diving are the most common recovery methods. Maricultural activities, though mostly for research and development purposes, occur for albacore, salmons, striped bass, lobsters, crabs, oyster, and mussels. A more detailed discussion of fish landings, catch composition, and port landings is included in Section III.C.5 (pp III-88 to III-98) of the FEIS for Proposed OCS Lease Sale 73 (U.S. Minerals Management Service, 1983) and Winzler and Kelley (1977).

### (4) Recreation and Tourism

The central California coast is a highly sensitive natural resource area and is an important recreational asset to the residents of the State and to tourists. Along the coast, recreation is primarily water-dependent and water enhanced and encompasses both active participation and aesthetic and passive aspects. There are numerous public and privatly owned recreational sites which have direct access to the ocean (see Figure III.C.3.c.(4)-1).

A complete listing of recreational sites is presented in POCS Technical Paper No. 81-5 (The Granville Corporation, 1981). Access sites have been listed and described for the California Coast by the Coastal Commission in the Califrnia Coastal Access Guide (1981).

These areas have a total shoreline of over 219.2 km (136.2 miles) which is more than 38.94 percent of the 562.9 km (349.8 miles) ocean shoreline of the central Coast. This, in turn, permits visitors' access to the ocean with relative ease in order to pursue whatever activity they desire.

Water dependent marine recreation includes such activities as boating, fishing, surfing, swimming and diving. Each one of these recreational activities is dependent upon an accessible and unpolluted marine environment. Most of these activities occur in sole association with established shoreline park, recreation, beach and public access sites.

Other recreational activities closely associated with the coastal and offshore environment of central California are water enhanced. The ocean provides a setting which enhances the enjoyment of such activities as beach use, sightseeing, picnicking, camping, golfing and off-road vehicle use. Like water dependent activities, most water enhanced recreational activities potentially affected by OCS exploration and development occur along the shorefront park, recreation, beach camping and public access sites. The most intense use of available recreational resources is generally found in close association with the major coastal population centers (San Francisco, Santa Cruz and Monterey).

Public recreation lands such as Golden Gate National Recreation Area which has over 28 miles of shoreline including Pacific Coast, and San Francisco Bay accounts for over 20 million visitors a year, half or more of which are to beach areas. Private areas as well, such as the 17-Mile Drive around the Monterey Peninsula, attracts millions of people annually, primarily because of the natural and scenic qualities of the Pacific Coast shoreline. Seasonality and weather also have a major temporal influence on the intensivity and extensivity of recreational activity.

The Granville Corporation (1981) assessed the economic value of recreational expenditures by residents of central California at over $450 million per year. More important than economics is the social and welfare value of recreation to individual citizens.

Sportfishing is an important recreational activity throughout central California.

Fishing from boats takes place along the entire coast, however, it is concentrated in areas such as San Francisco Bay, Monterey Bay and Tomales Bay. The distribution of boating and the number of participation days for the California Coast are given in POCS Technical Paper No. 81-5 (Granville Corporation 1981).

Tourism is one of the major industries in California, and has been recognized as an important element in the regional economy.

San Francisco is the most important tourist center in central California, due mainly to the number of major tourist attractions which are there. Most of the coastal communities can be considered tourist centers, as they are economically dependent upon both transient and stationary tourism. Transient tourism is popular along the coast as can be seen by the number of tourists who drive along sections of the coastal highway. Stationary tourism is important in that the total expenditure of the tourist will be added to the local economy, and will also have a direct bearing on the sportfishing and recreation of the local area.

In 1979, San Francisco County had a travel expenditure of almost $2.5 billion (California Office of Tourism, 1981), which was 17.8 percent of the total State travel expenditure. Of the total spent by tourists, approximately 46 percent is spent for hotel/motel use (California Office of Tourism, 1981); thus, in San Francisco County, approximately $1.1 billion was spent on the traditional form of tourism.

The overall value of tourism for the central California Coast in 1979-1980 as determined above was estimated at $1.56 billion and this is expected to increase to over $2.8 billion by the year 2000.

The central California coastline is an outstanding visual resource of great variety, grandeur, contrast and beauty, and contributes to the economic success of the tourist industry.

The systematic analysis of scenic quality is a complex and difficult task because of the great variety of natural and man-made conditions along the California coast. The Bureau of Land Management has developed a rating system that attempts to objectively rate, on a regional scale, the visual quality of the various landscapes on the California coastline.

The rating of the coastline, although subjective, does present the aesthetic quality of the coastline on a physiographic scale. This permits a relative aesthetic quality of the California coast to be obtained; however, the use and accessibility levels for each unit is not considered. The complete results of the study are given in POCS Technical Paper No. 81-5 (The Granville Corporation, 1981); however, the values given in the study should not be taken as absolute, but should be used to show the relative trend of the asesthetic value of the coastline.

Accessibility of the areas tend to be less, or virtually nonexistent, for the more pristine areas and thus, these areas tended to have less use than the more developed and easily accessible areas. Some areas have high recreational use due to their being accessible, having a relatively high aesthetic rating, and being close to centers of population as is seen at the Golden Gate National Recreational Area.

### (5) Cultural Resources

The coastal lands contain numerous archaeological sites, most of which represent Native American resources. In 1977 there were a total of 2,400 known archaeological sites in the coastal counties of central California. These sites are not evenly distributed over the coast but range from a low of 26 in San Francisco County to a high of 959 in Sonoma County. The heavier concentration of sites recorded in some counties is partially a reflection of large indigenous populations and mainly the result of the degree and intensity of surveying.

In addition to the prehistoric sites, there are over 503 historic sites in the coastal counties, many of which are in the National Register of Historic Places and/or on the California State Register.

There are presently about 8,000 Native American residents in the central coastal counties, although many are from other areas and States.

Over 600 shipwrecks of historic interest have been reported along the coast of8 central California.

### (6) Marine Vessel Traffic

The California Coastal Fairway system for central California was originally proposed by the Coast Guard in the Federal Register on 14 October 1982 (47 CFR 46043). Recent modifications would establish a fairway system consisting of two traffic lanes each one mile wide, separated by two miles. The original proposal included a five-mile wide Safety Fairway. The Twelfth Coast Guard District (central and northern California) is awaiting the results of the Port Access Route (PAR) Study of the Eleventh Coast Guard District (Southern California) extending the Santa Barbara Channel Traffic Separation Scheme (TSS) north to 35°. The results of this study will be coordinated with other PAR studies to determine the best and a consistent coastal fairway system for the entire coast between San Francisco and Los Angeles/Long Beach (Walker, personal communications, October 1984). There are currently no established shipping lanes along the coast north of San Francisco. The San Francisco TSS includes approaches to the bay from the north, south and west and a precautionary area and shipping safety fairway of 6-mile radius. The erection of structures within this shipping safety fairway is prohibited. See Table III.C.3.c.(6)-1 for a summary of major port activity levels.

### (7) Military Uses

Military activity along the central California coast primarily involves the Navy and Air Force. Activities include: flight training, missile firing and testing, submarine diving and transitting and anti-submarine warfare training (see Figure III.C.3.a.(6)-1). Much of the activity is conducted on a daily basis and is considered vital to overall national security. For the most part, most of the offshore activity begins at least 6 to 15 miles offshore, leaving a fairly wide margin for nonmilitary activity closer to shore.

### (8) Native Subsistence

(See discussion in Section III.C.1.c.(8) and III.C.4.c.(8)).

## Table III.C.3.c.(6)-1
## Marine Vessel Traffic - Major Ports of Central California

Source: U.S. Department of the Army, Corps of Engineers. Waterborne Commerce of the United States, Calendar Year 1982, Part. 4. July 1984.

| Port | Total Number of Vessel Trips (Includes self and non-self propelled, excludes domestic fishing craft) | | Total Freight Traffic (Short Tons) |
|---|---|---|---|
| | Inbound | Outbound | |
| Sacramento River CA (including the Port of Sacramento) | 209 | 214 | 2,016,475 |
| San Joaquin River and Port of Stockton, CA | 809 | 818 | 2,759,139 |
| Total San Francisco Bay and Delta Areas | | | 57,622,915 (adjusted) |
| San Francisco Bay Entrance | 5,414 | 5,416 | |
| San Francisco Harbor | 9,640 | 9,612 | 1,654,777 |
| Oakland Harbor | 3,390 | 3,385 | 6,985,134 |
| Richmond Harbor | 2,936 | 2,928 | 15,394,697 |
| Carquinez Strait | 2,625 | 2,647 | 18,891,545 |
| San Francisco Bay Other Ports | 7,472 | 7,465 | 7,884,723 |
| Crescent City Harbor | 55 | 46 | 98,283 |

## 4. Southern California

### a. Physical Environment

#### (1) Geology

The southern California planning area includes the northwest-southeast trending Coast Ranges and Peninsular Ranges provinces, separated by the east-west trending Transverse Range. The northern Channel Islands are along the boundary between the Transverse and the Peninsular Ranges provinces. The west-trending Transverse Ranges include the Santa Barbara Channel and the Channel Islands. The offshore portion of the Peninsular Range province, characterized by the highly irregular topography of basins and ridges, is commonly referred to as the southern California continental borderland.

The Santa Barbara basin, a tectonic depression that forms the western extension of the onshore Neogene-aged Ventura basin, is the submerged southwestern part of the Transverse Range province (Vedder, et al., 1969). This trend is commonly referred to as the Santa Barbara Channel. The Channel extends 130 km along its east-west axis and averages 40 km in width. Maximum water depth in the Channel is about 625 m. The characteristic west-trending structural grain of the Transverse Range province is reflected in the structures of the basin. The major structures in the Santa Barbara Channel region are east-west oriented folds and faults. The basin floor is composed of Quaternary sediments, as much as 2,000 m thick, that are gently folded and faulted in most areas but are undeformed in many others (Curran, et al., 1971; Vedder, et al., 1974).

The area south of the Channel Islands, the southern California continental borderland, is the north and west offshore extension of the Peninsular Range province. This area is characterized by a series of complexly folded and faulted north-northwest-trending ridges and basins that parallel the structural grain of the onshore Peninsular Range province. The basins are under water depths of 400-2,000 m, whereas water depths above the flat-topped ridges and coastal shelves are usually less than 150 m. The southern California continental borderland may be divided into the inner basins and ridges and the outer basins and ridges. The outer ridges are sites of erosion, whereas, the outer basins are sites of deposition.

The offshore Santa Maria basin extends northward from Point Conception beyond the northern boundary of the planning area to approximate latitude 36°15N. It is a middle to late Tertiary depositional basin overlying a pre-Tertiary structural high. The offshore portion of the basin is approximately 225 km long and 40 km wide. It is separated from the Santa Barbara basin southwest of Point Conception by a ridge formed by the truncated edges of the Paleogene sediments in the Santa Barbara Channel. The basin is bounded by the Santa Lucia bank on the west and by Franciscan rocks elevated along major coastal faults on the northeast. Major structures within the basin parallel the shoreline and the bordering structural high which is expressed by the Santa Lucia Bank (Hoskins and Griffiths, 1971).

### (2) Geologic Hazards

Potential geologic hazards identified offshore southern California are seismicity, active faults, mass transport of sediments, steep slopes and steep-walled canyons, buried and filled channels, hydrocarbon seeps, shallow gas, and tsunamis. Potential geologic hazards for portions of offshore southern California have been described for pre-lease geohazards analyses prior to OCS Lease Sales 48 (Richmond, et al., 1981) and 68 (Vedder, et al., 1980; Burdick and Richmond, 1982). Recent reports by Edwards (1982a, b) and Clarke, et al. (1983) specifically address the geologic hazards for the proposed planning area.

#### (a) Seismicity

Southern California lies along a portion of the complex Pacific-American plate boundary that is within the circum-Pacific volcanic and seismic belt. This area has been tectonically active throughout middle and late Cenozoic time. Tectonism has accelerated during the latter part of this era, with maximum activity occurring in Quaternary time (Hamilton and others, 1969).

Reliable accounts of California earthquakes date from the early 1800's and, in southern California, seismicity has been monitored since the 1920's. Since 1932, the California Institute of Technology has maintained a seismic monitoring network in southern California. A network of seismographic stations surrounding the Santa Barbara Channel was established by the U.S. Geological Survey in 1969. The University of Southern California (USC), under contract to the Minerals Management Service, monitors the seismicity of the Dos Cuadras oil field in the Santa Barbara Channel. The USC seismic network, consisting of four sea-floor stations and three land-based stations, has been fully operational since January 1979. The Minerals Management Service and USC have also established a seismic monitoring network around the Beta oil field on the San Pedro shelf.

Reliable accounts of California earthquake date from the early 1800s and in northern and central California earthquakes have been instrumentally recorded by the University of California, Berkeley since 1887 (see Section III.C.2.a.(2)(a). Offshore Santa Maria basin largely lies within the gap between two seismic networks; therefore many small magnitude events (<4.0) probably were not detected and the locations of those recorded may be unreliable.

The Santa Barbara Channel has a history of significant seismic activity. Studies of the 1970-1975 seismic activity in the Santa Barbara Channel by Lee and others (1979) show that the epicenters aligned with east-trending reverse faults. Fault-plane solutions geometrically associate one or more events with segments of the Red Mountain, Pitas Point-Ventura, Mid Channel, and other east-trending faults (Lee and others, 1979).

The offshore Santa Maria area lies adjacent to one or more seismically active faults (see Geologic Hazard Visual for OCS Lease Sale No. 73, MMS, 1983) and, therefore may be expected to experience seismically-induced ground motion. The expected maximum bedrock acceleration of this offshore area during a 100-year period is between 0.1g and 0.2g and about 0.6g during a 2,500 year period (Thenhaus and others, 1980).

Although there is an extensive seismographic network onshore southern California, the coverage offshore is sparse. Seismicity data are scant and inconclusive. Predictions of maximum credible earthquakes and recurrence intervals have not been established for the continental borderland. Seismicity coverage of the outer basins and ridges is practically nonexistent.

### (b) Faulting

Numerous faults in the offshore area of the Santa Maria basin are active. The Hosgri fault zone trends along the eastern margin of the offshore Santa Maria basin for at least 145 km and is considered active. The maximum probable earthquake occurrence for the Hosgri fault zone is estimated to be magnitude 6.5 (Smith, 1974) to 7.3 (McCulloch and others, 1980). The Lompoc fault zone, within the offshore Santa Maria basin, and the Santa Lucia Bank fault, along the western boundary of the Santa Maria basin at the base of the Santa Lucia Bank are both considered to be active.

Numerous faults, many of which are considered active, are located offshore southern California. In the Santa Barbara Channel, active faults include the South Branch Santa Ynez, Mid-Channel, Pitas Point, and Oak Ridge faults. An unnamed series of faults at the base of the Channel Islands Platform in the southwest Santa Barbara Channel is also considered active. The west-trending Santa Rosa Island/Santa Cruz Island/Malibu Coast fault system separates the Santa Barbara Channel from the southern California continental borderland and is considered active.

In the southern California continental borderland, many shallow, near surface faults cut the mainland shelf and outer ridges. Beneath the flanks of the ridges and in the basins, faults are less numerous but are longer and have greater apparent vertical separation than faults on the ridge crests (Vedder and others, 1980). Active faults mapped on the mainland shelf and in the inner basins include the Cabrillo, Palos Verdes Hills, Rose Canyon, and NewportInglewood fault zones. In the outer banks area, many faults intersect the sea floor where Tertiary-aged bedrock is exposed. It is difficult to determine whether this is a true indication of the age of the faulting or if exposure of the faults at the sea floor is due to the thinness or absence of Quaternary sediments. The angularity of some sea-floor scarps implies that some displacement may be Quaternary in age (Clarke and others, 1983). Numerous faults of Quaternary age are mapped on the lower slopes and basin floors where fine-grained Pleistocene and Holocene sediments are prevalent. Two major fault zones are identified in the outer basin and ridge area; these are the Ferrelo fault zone along the west flank of the northern Santa Rosa-Cortes Ridge and "San Nicolas" fault zone along the south flank of the San Nicolas Island platform.

### (c) Mass Transport

Evidence of sediment failure resulting in downslope mass transport is relatively common offshore southern California. Other forms of failure (for example, liquefaction) are difficult to detect and it has not been possible to determine their prevalence. Many conditions giving rise to sea-floor instability are characteristic of offshore southern California; among these are localized thick accumulations of unconsolidated, water-saturated sediment, steep slopes, and seismic and storm activity (Field and Edwards, 1980).

Mass-transport deposits are common along the northern slope of the Santa Barbara Channel and cover more than 20 percent of the central channel. Buried disturbed strata suggestive of past episodes of mass transport have been noted in seismic profiles across the base of the Channel Islands Platform (U.S. Geological Survey, 1976). Evidence of sea-floor failure is common on slopes in the continental borderland. Slump deposits have been identified along the continental slope and along the flanks of the inner and outer ridges.

Mass-transport deposits are associated with channel and interchannel environments on the surface of Conception Fan southwest of Point Conception at the extreme west end of Santa Barbara Channel. Slump deposits are common in the submarine canyons of the continental borderland and form as a result of the undercutting of terrace and levee deposits by currents or by sediment transport in the canyons. The intermittent channel fill in these canyons is highly mobile and unstable.

One large mass-transport deposit (approximately 44.5 sq. mi. [115.3 sq. km]) and at least three smaller failures have been identified in offshore Santa Maria basin (McCulloch and others, 1980; Richmond and others, 1981).

### (d) Steep Slopes and Steep-Walled Canyons

Steep slopes in the Santa Barbara Channel are common along the flanks of the Channel Islands Platform and along the mainland slope. Moderate and steep slopes are common along the mainland slope and along the flanks of the ridges in the southern California continental borderland. Steep slopes occur locally within the submarine canyons of the southern California continental borderland. Buried and filled channels are associated with the Conception (Pescado) submarine fan south of Point Conception. Shallow buried channels pose a potential hazard due to possible contrasts in load-bearing capacity within the infilling sediments and between the infilling sediments and the surrounding sediments.

### (e) Hydrocarbon Seeps

Most documented natural hydrocarbon seeps identified offshore southern California are located in the Santa Barbara Channel and on the Santa Monica and San Pedro shelves.

### (f) Shallow Gas

Shallow gas occurs within the Santa Barbara Channel as rare, small ($\leq$ 1 sq km), isolated pockets in the western end of the channel confined almost exclusively to Pliocene and Pleistocene rocks (Burdick and Richmond, 1982.

Extensive gas-charged sediment zones occur along the shelf break at the northern edge of the Santa Barbara Channel. Many gas-charged sediment zones occur in association with faulting in the eastern Channel.

Shallow gas zones occur in the Pliocene andPleistocene rocks along the coastal shelf from Palos Verdes to the Mexican border. Shallow gas also occurs on the San Pedro shelf as scattered pockets associated with faulting (Burdick and Richmond, 1982). There are few gas-charged sediment zones identiied in the southern California continental borderland.

#### (g) Tsunamis

Locally generated tsunamis have been recorded along the coast between Point Conception and the Mexican Border; however, these are few in number nd have not caused major damage. DOI (1981 and 1984) addresses the occurrance of tsunamies in the Southern California Region.

### (3) Non-Petroleum Mineral Resources

#### (a) Phosphorite

Southern California marine phosphorite nodules are hard, dense masses varying in size from boulders to silts, are generally brown or black in color, and typically have a glazed or shiny surface. They are composed of cryptocrystalline matrix and lsser amounts of pellets, detrital mineral grains, glauconite, fossil fragments and reworked phosphorite clasts. The deposits probably accumulate in relatively shallow water under anoxic or reducing conditions, particularly on submarine banks in areas of pwelling. See Figure III.A.3-1 in the Proposed Southern California Lease Offering, April, 1984 for general locations.

#### (b) Sand and Gravel

Preliminary study of the possible aggregate sources in the offshore waters of outhern California indicates that large quantities of gravel, sand and shell are present in the southern California borderland. Large accumulations of gravel, in water depths shallow enough to be recovered, are present: (1) near San Diego, adjacent to Imperial Beach and the Tijuana River, (2) on the San Pedro shelf, west of the Palos Verdes Hills fault, and (3) on the Santa Monica shelf, offshore of Ballona Creek.

Sand deposits of deltaic progradation existing in a high energy regime are found west of Santa Maria and Lompoc each deposit cover an average area of approximately 2 km2.

### (4) Oceanography

#### (a) Chemical Oceanography

Chemical oceanography of the Southern California Bight has been described in several publications including the FEIS for Sale No. 48 (USDI, 1979), OCS Sale No. 48 Reference Paper No. II (USDI, 1978a), The Sea Off Southern

California (Emery, 1960), and Southern California Coastal Water Research Project Report TR 104 (1973). The ocean in the Southern California Bight is typical of nearshore marine waters with disolved oxygen values in the range of 5.5 to 6.5 ml per liter for surface water, salinity in the range 33.0 to 34.0, and varying nutrient levels depending upon proximity to local upwelling areas, rural runoff, and municipal sewage outfalls. Ranges for nitrate, phosphate, and silicate are 0 to 12, 0.2 to 1.4, and 0 to 16 micrograms atom per liter respectively reported at CalCOFI station 80052 (CalCOFI, 1976). Trace metals are generally in the range of 50 to 250 parts per trillion for disolved metals in sea water (Bruland and Franks, 1983).

Sources of nutrients to the coastal waters off Southern California are upwelling, waste discharge, land runoff, precipitation and the decomposition of organic matter. Upwelling is the most significant source of nutrients to the surface layers of the water column.

Although the supply of nutrients from waste discharges is less than that supplied through upwelling, the supply from waste discharges tends to be relatively constant throughout the year. Municipal wastewater tends to be localized and diffused below the euphotic zone.

The enhancement of nutrient input in the outfall areas increases chlorophyll concentration and phytoplankton growth in comparison with those from nonoutfall areas. Associated with such enhanced phytoplankton production are high concentration of chlorophyll-a, adenosine triphosphate (ATP), and particulate organic carbon and nitrogen. There are no appreciable differences in the concentrations of nutrients or dissolved organic constituents, e.g., dissolved organic carbon, nitrogen and phosphorus, and viatamins B12, B1 (thiamine) and biotin, between outfall areas and the normal coastal background (Chan, 1974).

### (b) Physical Oceanography

Hydrographic Conditions: The Southern California Planning Area includes the Southern California Bight from San Diego to Point Conception, as well as the coasts of the counties of Santa Barbara, north of Point Conception, and San Luis Obispo. The Bight has distinctly different hydrographic conditions from those found north of Point Conception due to the influence of tropical waters in this region.

Temperature and salinity in this planning area are related to the circulation. Intrusions of warm water into the Bight from the south are common and can readily be seen in satellite imagery. On the average, the temperature of the surface waters in the Bight can reach 18°C-20°C in late summer or early fall, and 13°-15°C in late winter (Robinson, 1976). North of Point Conception the surface temperature can be substantially cooler, especially if upwelling is taking place, and is similar to that of the Central California Planning Area. The salinity within the Bight varies from 33.3% to 33.6% (SCCWRP, 1971).

Large scale circulation: The California Current system dominates the large scale circulation in this planning area. North of Point Conception, the

California Current flows southward along the coast most of the year. At Point Conception, where the coastline breaks sharply to the east, the California Current continues to flow to the southeast, more or less along the seaward margin of the continental borderland. Part of this flow gradually turns eastward and along the central Baja California coast contributes to the northward Southern California Counter Current which flows along the coast in the Bight until it reaches Point Conception, thus completing a large scale cyclonic (counter clockwise) gyre. The intensities of the flow within the various segments of this gyre vary with time, as will be discussed below. North of Point Conception there is an intermittent northward flow, the Davidson Current, which may be related to the Southern California Counter Current, although this very much is still in question.

There is not much current meter data upon which to base discussions of the three dimensional nature of the circulation within the Bight. Most current meter measurements have been made very near the coast. North of Point Conception current meter returns from the Central California Coastal Circulation Study should be available by the final EIS. Tsuchiya (DSR, 17A, 1979) describes nearshore currents deduced from hydrographic sampling between San Diego and Los Angeles. Winant JPO, 10(5), 1980 describes current recorded by current meters within about 4 km of the beach at Del Mar (between La Jolla and Oceanside).

Factors Influencing Circulation: The long-term average wind stress over the Southern California Bight is northwesterly throughout the year (Nelson, 1977). There is a marked increase in the magnitude of stress with distance offshore. In the offshore region of the Bight (beyond about 50 n miles) it is greatest in summer. The nearshore wind stress on the average is considerably smaller except for synoptic events such as cold frontal passages in winter and "Santa Anas" in summer and fall.

This configuration of wind tends to support the observed large scale average circulation observed in the Bight, that is, the geostrophic flow has been found to be well correlated with the local average wind stress (Tsuchiya, DSR, 27A, 1980).

Winant (JPO, 10(5), 1980) describes the response of the nearshore circulation to wind stress associated with tropical storms which travel northward along the Baja and Southern California coasts. These wind events cause downwelling, resulting in an increase in the mean temperature over the shelf (caused by cross shelf heat transport) and are associated with large long shore accelerations throughout the water column over the shallower part of the shelf.

Modes of Variability: The seasonal cycle north of Point Conception in the Southern California Planning Area is similar to that described for the Central California Planning Area. South of Point Conception the seasonal cycle is seen in an onshore-offshore shift in the position of the California Current (Tsuchiya, 1980). In April and May the California Current extends farthest inshore, at times eliminating the Southern California Counter Current. In the winter the Southern California Counter

Current is most well developed and the California Current is farthest offshore (Tschiya, 1980).

The 1982-83 El Nino was strongly expressed in the Southern California Planning Area (Fielder, Science).

### (5) Water Quality

Water quality off the coast of southern California is generally good, but localized areas are measurably degraded and many small sources of pollutants exist. The most pristine waters occur on the outer banks and basins (e.g., Tanner-Cortes Banks) the windward sides of the Channel Islands, and the area north of Pt. Conception. Upwelling during the spring and summer tends to affect certain water quality parameters; dissolved oxygen is lowered, nutrients and carbon dioxide concentrations are increased in coastal water when deeper, cooler water is upwelled into shallow depths. Natural petroleum seeps contribute significant amounts of hydrocarbons (Fischer 1978). Major anthropogenic effects on water quality are associated witb the wastes and activities of more than 12 million people who live in the southern California area, and include municipal wastes, runoff, aerial fallout, harbor discharges, thermal discharges, and materials from boats and ships (Bascom 1982).

Five municipal outfalls located at Ventura, Santa Monica Bay, Palos Verdes, Orange County and San Diego contribute relatively major affects to the water quality in the region. These five outfalls discharge over 1 billion gallons of wastes/day and carry large quantities of suspended solids, hydrocarbons, nutrients, and metals into coastal waters (Southern California Coastal Water Research Project 1980). The benthic areas that have been degraded or altered by the municipal discharges have been described and mapped by Bascom (1982) and total about 147 km2.

As part of the "mussel watch" program, Stephenson, Martin and Martin (1978) have used Mytilus sp. as an indicator of water quality throughout the California coast. The geographical variation in metals (Ag, Pb, and Zn) and hydrocarbon concentrations showed an overall increase toward the south; relatively high levels of metals were found in mussel tissue off the population centers around Ventura, Los Angeles and San Diego. Hydrocarbon levels were relatively high near Santa Barbara where natural oil seeps exist.

### (6) Ocean Dumping

Ocean dumping in the southern California area has been discussed in detail in the FEISs for OCS Lease Sale No. 73 (MMS, 1983), and for the Proposed Southern California Lease Offering, April, 1984 (MMS, 1986). There are 38 designated historic and active dump sites off the coast of southern California. (see Figure III.C.4.a.(6)-1). Materials dumped depend on the type of permit issued by the Environmental Protection Agency (EPA), and vary from industrial and municipal wastes to dredge spoils, low level radioactive waste, and obsolete munitions. Low level radioactive waste has

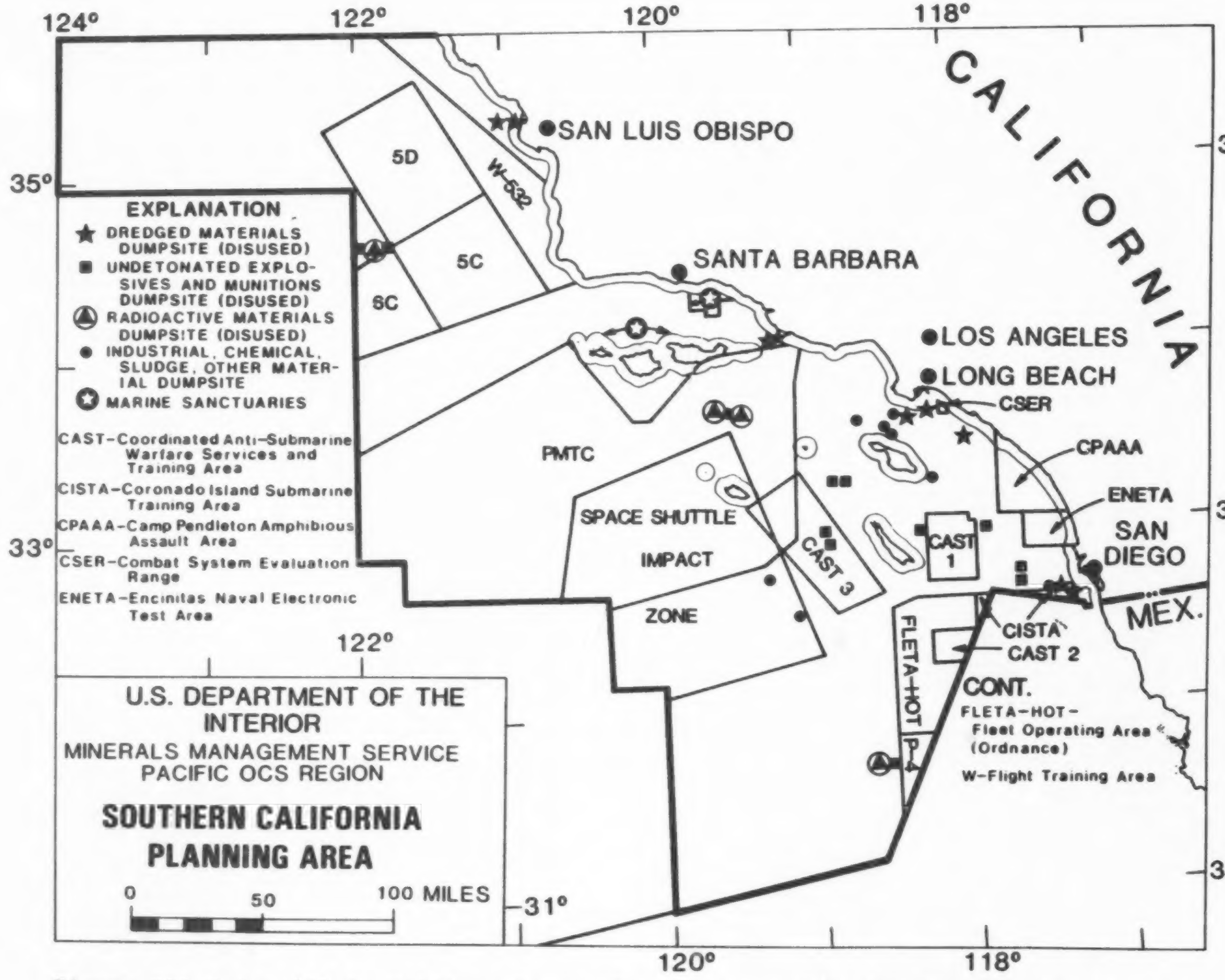
124°
122°
120°
118°
35°
33°
31°
CALIFORNIA
SAN LUIS OBISPO
SANTA BARBARA
LOS ANGELES
LONG BEACH
CSER
CPAAA
ENETA
SAN DIEGO
MEX.
5D
5C
5C
W-532
PMTC
SPACE SHUTTLE
IMPACT
ZONE
CAST 3
CAST 1
CISTA
CAST 2
FLETA-HOT
P-4
CONT.
FLETA-HOT-Fleet Operating Area (Ordnance)
W-Flight Training Area
EXPLANATION
★ DREDGED MATERIALS DUMPSITE (DISUSED)
■ UNDETONATED EXPLOSIVES AND MUNITIONS DUMPSITE (DISUSED)
RADIOACTIVE MATERIALS DUMPSITE (DISUSED)
● INDUSTRIAL, CHEMICAL, SLUDGE, OTHER MATERIAL DUMPSITE
MARINE SANCTUARIES
CAST-Coordinated Anti-Submarine Warfare Services and Training Area
CISTA-Coronado Island Submarine Training Area
CPAAA-Camp Pendleton Amphibious Assault Area
CSER-Combat System Evaluation Range
ENETA-Encinitas Naval Electronic Test Area
U.S. DEPARTMENT OF THE INTERIOR
MINERALS MANAGEMENT SERVICE
PACIFIC OCS REGION
SOUTHERN CALIFORNIA PLANNING AREA
0
50
100 MILES

Figure III.C.4.a.(6)-1. Military Areas, Dumpsites, and Marine Sanctuaries in the Southern California Planning Area.

not been dumped at sea by the U.S. since 1970. EPA's final revision of regulations and criteria for ocean dumping (FR January 11, 1977, Part VI) prohibit ocean dumping, except by permit, in the territorial sea out to 22 km (12 nautical miles) from shore, except fish wastes, fisheries resources, routine discharge from vessel propulsion and construction of fixed structures and emergency situation to safeguard life at sea.

### (7) Climate

The climate of the southern California coastal and offshore area is described as Mediterranean Coastal type with warm, dry summers and relatively mild, wet winters. Precipitation is primarily confined to the months of November through April. The dominant weather control for the southern California area is the semi-permanent Pacific Subtropical High. During the summer, the high reaches its maximum intensity and northernmost position. This stable air mass prevents any significant rainfall. During the winter season the Pacific High weakens and moves southward allowing Pacific storms to move through the area bringing periodic cloudiness and rain. Winds are primarily northwesterly, with the exception of the Santa Barbara Channel and southern California Bight where winds tend to be more westerly. Average wind speeds range from 6 to 15 knots. Temperature inversions exist along the southern California Coast primarily in the summer and early fall. Inversion conditions lead to low clouds and fog in the coastal regions, especially during the night and morning hours. Sunnier and warmer conditions prevail inland as the marine layer breaks down due to rapid solar heating. For a detailed discussion of climate for the southern California area, see the FEIS for Lease Sale No. 48, Lease Sale No. 73 and the Proposed Southern California Lease Offering, April, 1984.

### (8) Air Quality

Air quality in a particular area depends upon the prevailing weather conditions, local topography, and the amount of pollutants being emitted into the air. The State and Federal governments have established levels of contaminants which should not be exceeded in order to protect public health and welfare. In California, the pollutants that frequently exceed these air quality standards are ozone (O3), Total Suspended Particulates (TSP) and nitrogen dioxide (NO2). Ozone, the most common air pollutant in southern California, is formed by the reaction of nitrogen oxides and hydrocarbons in the atmosphere under the action of sunlight. Ozone levels are highest during the summer and early fall due to intense sunlight, and a strong inversion layer. Locations downwind (inland) of major urban emission sources are most severely affected by ozone. All of the coastal Air Basins, except for San Luis Obispo County, are classified nonattainment for ozone. Most of the coastal areas are also nonattainment for TSP. All areas, except for the South Coast Air Basin, are in attainment of the NO2 standard. For a detailed discussion of State and Federal air quality standards and observed pollutant levels for the Southern California area, see the FEIS for Lease Sale No. 73 and the Proposed Southern California Lease Offering, April, 1984.

## b. Biological Environment

### (1) Plankton

Phytoplankton and Zooplankton are discussed in detail for California in the Sale No. 48 Final Environmental Statement. The most significant characteristic of Pacific Coast plankton ecology is upwelling, which occurs during the spring (April or May) in southern California and later in the summer on the rest of the coast. The subsurface water is cold (10°C) and rich in the nutrients which rise to the surface of the coastal waters during periods of upwelling. The combination of abundant nutrients and adequate sunlight allows prolific phytoplankton growth (up to several million cells per liter during blooms) in the upper 50 meters of water. Zooplankton abundance is closely related to the biomass of phytoplankton, as the latter serves as the primary food source for zooplankton. Therefore, zooplankton abundances follow phytoplankton abundances, although with a characteristic lag of several weeks, representing an exploitation and utilization phase of the plants by zooplankton.

### (2) Benthos

#### (a) Intertidal Benthos

The shoreline of southern California mainland coast primarily consists of sandy beaches. According to Littler and Littler (1980), the percentage of sandy intertidal habitat from the Mexican border to Point Conception is 75 percent for the upper intertidal and 64 percent for the lower intertidal.

Conversely, Littler (1979) found the offshore islands have primarily rock or boulder intertidal habitat. The mean percentage of sandy beach is approximately 20 percent, while the mean percentage of rocky intertidal habitat is approximately 60 percent. The area between Point Conception and San Luis Obispo County line consists of approximately 30 percent rocky intertidal and 70 percent sandy beaches.

##### (i) Rocky Shore Intertidal Communities

More detailed information of the intertidal can be found in Murray (1974), Ricketts, Calvin and Hedgpeth (1968), Carefoot (1979), Straughan and Kanter (1977, 1978, 1979), Littler (1977, 1978, 1979a, b), Littler and Littler (1980), Straughan (1977, 1978, 1979), and BLM (1975, 1978a, 1978b, 1979, 1980 and 1981).

Littler and Associates (Littler, 1979) reported 539 species at 22 Southern California Bight locations during the 3-year (1975 to 1978) BLM study. All these species were macroorganisms and consisted of 224 macrophyte (plants) and 315 macroinvertebrate species. Most species appeared to be restricted to certain geographic portions of the Bight.

The assemblages on the offshore islands are more productive and have larger species diversities than those on the mainland shelf. The similarity grouping based on Littler (1978) and Kanter (1978) are shown in Table III.C.4.b.(2)-1.

Only 42 species (25 macrophyte, and 17 macroinverterbrate) were found at all locations (Table III.C.4.b.(2)-2).

As indicated above, scientific literature on rocky intertidal communities north of Point Conception is spotty with a few areas very well studied. Much of the rest of the coast has not been systematically studied. Woodward and Clyde (1982), however, has surveyed the entire area from helicopter.

The segment of southern California north of Point Conception is within the Oregonian biogeographical province which begins at Point Conception and extends to Puget Sound, Washington or Prince William Sound, Canada depending on the author (Valentine, 1966).

Extensive intertidal sampling has been conducted at Government Point, part of the Point Conception complex (Littler, 1978, 1980; Martz and Littler, 1979) and at Point Arguello (Chambers Consultants and Planners, 1980; Rodrique et al., 1976 and Newswanger, in Chambers Consultants and Planners, 1980).

Around Point Conception, there are a number of species with a limited geographical range. Littler and Littler (1980) reported the most pronounced break between warm and cold water algae occurred at Government Point. The species diversity at Government Point was the highest of all intensely studied mainland sites in southern California (Littler, 1980). At Point Arguello, approximately 19 km (12 mi.) north of Point Conception, Littler and Littler (1980) reported a unique dense population of intertidal black abalone which may serve as brood stock for much of the mainland coast of southern California. Newswanger reported from preliminary analysis that the geographic range of 17 species of littoral molluscs ended at the Point Conception boathouse.

Little has been written about endemic species north of Point Conception, partly because few investigations have been conducted in the area. Intertidal and shallow subtidal areas just north of Point Conception are assumed to have some endemic species by virtue of their proximity to the division between major biogeographic provinces. The Minerals Management Service (1983) has listed the sensitive rocky intertidal areas of northern and central California (Table III.C.2.b.(2)-1).

### (ii) Sandy Beach Intertidal

The environment of the exposed sandy intertidal is considerably less stable than that of the rocky intertidal. Every wave on a sandy intertidal beach moves a great deal of sand.

Organisms on surf-swept sandy beaches achieve protection from wave shock by burying themselves in the sand (burrowing). That sandy beaches have limited populations is not unexpected.

Because of the continued restructuring of sandy beaches, the number of individuals per species varies greatly from year to year. There is,

## TABLE III.C.4.b.(2)-1

## SITE GROUPINGS BASED UPON SIMILARITY OF ROCKY INTERTIDAL AND MUSSEL ASSEMBLAGES FROM COMBINED CLUSTER ANALYSIS FROM LITTLER (FREQUENCY AND COVER) AND KANTER (SPECIES ABUNDANCE)

O = outer or seaward side of an island
I = inner or shoreward side of an island

Source: Littler (1978) and Kanter (1978)

**Northern Group (Islands)**
*Point Conception (Government Point)
San Miguel Island I, O
Santa Rosa Island I, O
San Nicolas Island O
Santa Cruz Island I

**Northern Mainland Group**
Santa Barbara Channel
eg: (Coal Oil Point)
(Goleta Point)
(Ventura)
Malibu

**Intermediate Islands Group**
Anacapa Island I, O
Santa Cruz Island O

**Southern Islands Group**
San Clemente Island I, O
Santa Catalina Island I, O
Santa Barbara Island

**Southern Mainland Group**
Oceanside - San Diego
Whites Point
Corona Del Mar
Dana Point

*Actually, this is a mainland site.

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## TABLE III.C.4.b.(2)-2

## TAXA COMMON TO ALL 22 STUDY SITES THROUGHOUT 1975-78

Source: Littler (1979)

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Macrophytes:

Blue-green algae
*Bossiella orbigniana ssp. dichotoma*
*Ceramium eatonianum*/*sinicola* (2)
*Corallina officinalis* var. *chilensis*
*Corallina vancouveriensis*
Crustose Corallinaceae (2)
*Gelidium coulteri*/*pusillum* (2)

*Ulva californica*/*lobata* (2)
*Egregia menziesii*
*Cryptopleura* spp. (4)
*Gigartina canaliculata*
*Polysiphonia* spp. (6)
*Rhodoglossum affine*

Macroinvertebrates:

*Phragmatopoma californica*
*Balanus glandula*
*Chthamalus fissus*/*dalli* (2)
*Pachygrapsus crassipes*
*Tetraclita squamosa rubescens*
*Anthopleura elegantissima*
*Acmaea* (*Collisella*) *limatula*
*Acmaea* (*Collisella*) *pelta*
*Acmaea* (*Collisella*) *scabra*
*Littorina planaxis*
*Littorina scutulata*
*Cyanoplax hartwegii*
*Nuttallina fluxa*/*californica* (2)

*Pagurus* spp. (2)

however, a characteristic group of animals which lives just below the low tide line or within the sand between the tidal lines. A few even live higher up the beach in burrows or beneath organic debris. Some of these organisms are active only at night or on cloudy days; others remain hidden in the sand.

Straughan (1977, 1978, 1979) reported that physical factors defining the energy regime of sandy beaches were probably directly responsible for the variation in biotic diversity observed. It is likely also that these factors play an important role in determining the actual species composition. The sand crab, Emerita dominated the fauna of the steepest, most unstable beaches. Worm associations are best developed on the flattest, most regular beaches such as Scripps, Point Loma, and Coal Oil Point.

Accounts dealing with sandy area north of Point Conception are few. A species of recreational and economic importance, the pismo clam Tivela stultorum, should be mentioned as an important member of this habitat.

### (b) Subtidal Benthos

The subtidal benthos of the California Bight is extremely complex, consisting of many species and assemblages, and is difficult to summarize. There are many reasons for this complexity: 1) Numerous available habitats are created by the topography of the continental borderline, islands, deep basins, submarine canyons, and the resulting sediment complexity; 2) The relatively stable temperature and salinity conditions favor a biologically accommodated system consisting of many species (Sanders, 1968); and 3) the Bight, especially the Santa Barbara Channel, is a biogeographic transition zone between the Californian and Oregonian Provinces with the division line at Point Conception (Valentine, 1966). Because the water temperatures and other factors are often typical of both provinces, the Bight has species of the northern Oregonian Province and the California Province, as well as species which are only found in the southern California Bight. Valentine (1966), for example, reported 180 endemic species of Bivalvia and Gastropoda having a north-south geographic range of only 60 miles within the Bight area.

Emery (1960) divided the Southern California Bight offshore area into the mainland shelf (from the mainland coast to the 100 m or 300 foot contour) and the continental borderline (from the 100 m contour line to the Patton Enscarpment, 50 to 150 miles offshore).

Fauchald and Jones (1977) indicated the single most important environmental variable governing the distribution of species was depth. It appeared to be significantly more important than sediment and area location, at least on the shelves and slopes.

The continental shelf of southern California north of Point Conception is essentially the same as that described for northern California.

Scientific Applications, Inc. has a contract through MMS to survey the benthic communities of southern California north of Point Conception. The data is being worked up at the present time. Other studies conducted for oil companies (Dames and Moore, 1982; Nekton, 1982; and, Chambers Consultants and Planners, 1980) have identified several tentatively new species.

For further information of subtidal benthos of southern California, see Sale No. 35 EIS, Sale No. 48 EIS, including Reference Papers No. II and III, Sale No. 53 and Sale No. 73 published by the U.S. Department of Interior (1975, 1978a, b, c, 1981, 1983, respectively). The BLM sponsored benthic studies, by Fauchald and Jones (1977, 1978), and the foraminiferan studies by Douglas (1977, 1978) also present valuable information.

### (3) Fish Resources

The marine environment off southern California is rich in fish life. Of the 562 species of coastal marine fishes known to occur in California (Miller and Lea, 1972), 485 species (87 percent) are found in southern California waters. These counts do not include all of the deepsea fishes. Southern California is a transition zone between southern warm-temperate, subtropical waters and northern cold-temperate waters. Thus, both warm-water and cold-water fishes are found either seasonally or year-round off southern California (Horn, 1974a). Another reason this area is rich in fish life is the wide variety of habitats created by the many banks, ridges and deep-sea basins that occur in this area. Significant upwelling also occurs in some areas. Nutrients from upwelling contribute to the food base and therefore productivity of the area. See Table III.C.4.b.(3)-1 for a list of representative fishes and their habitats for southern California. These species are discussed in detail in the FEIS for the Proposed Southern California Lease Offering, April, 1984, Section III.B.3.

The broadness of the continental shelf, the warmer ocean currents and the submarine habitat diversity are all factors which contribute to the abundance and diversity of fishes in the planning area. Additionally, existing offshore platforms are concentrating certain species and may be increasing total fish production. Also, sewage outfalls from numerous populated areas are releasing nutrients into the water which can serve to increase the base of local and regional food webs.

### (4) Marine Mammals

The large and complex marine mammal community of the Southern California Bight ranks as one of the most diverse faunas in north temperate waters. Not only does the SCB support resident populations, of which several have worldwide or regional significance, but it is also an area where many wide-ranging species overlap.

Over 75,000 pinnipeds and a similar number of cetaceans including seven species of endangered whales are present in the SCB. The location of the SCB at the periphery of the ranges of many species marks it as a zone of overlap of faunas which are characteristic of both temperate/subarctic and subtroptical waters.

Table III.C.4.b.(3)-1

## REPRESENTATIVE FISHES AND THEIR HABITATS, SOUTHERN CALIFORNIA

| Species | Habitat | | | |
|---|---|---|---|---|
| | Epipelagic | Benthic | | |
| | | Shallow | | Offshore |
| | | Sandy | Rocky | |
| Common thresher | X | | | |
| Pacific electric ray | | X | | X |
| Round stingray | | X | | X |
| Pacific herring | X | | | |
| Northern anchovy | X | | | |
| Surfsmelt | X | X | | |
| California grunion | | X | | |
| Pacific saury | X | | | |
| Rockfishes (sev spp) | | | X | X |
| Sablefish | X | | | X |
| Greenlings (sev spp) | X | | X | X |
| Cabezon | | | X | |
| Giant sea bass | X | | X | |
| Kelp bass | X | | X | |
| Sand bass (2 spp) | | X | X | |
| Jack mackerel | X | | | |
| Yellowtail | X | | | |
| White seabass | X | | | |
| California corbina | | X | | |
| Croakers (4 spp) | | X | X | |
| Surfperches (sev spp) | | X | | |
| Garibaldi | | | X | |
| California barracuda | X | | | |
| California sheephead | | | X | |
| Senorita | | X | | |
| Rock wrasse | | | X | |
| Kelpfish (4 spp) | | | X | |
| Monkeyfaced-eel | | | X | |
| Pacific mackerel | X | | | |
| Pacific bonito | X | | | |
| Albacore tuna | X | | | |
| Bluefin tuna | X | | | |
| Swordfish | X | | | |
| Striped marlin | X | | | |
| Flatfishes (sev spp) | | X | | X |

Five Pinniped species (California sea lion, northern fur seal, northern elephant seal, harbor seal and Stellar sea lion) breed and rear their young on the Southern California Channel Islands. Pinnipeds breed and rest on the island beaches and rocks of the SCB and feed in the inshore and offshore waters. Some animals, such as harbor seals and California sea lions, commute daily from their traditional hauling grounds to open-water foraging areas over shallow island shelves and offshore banks and ridges. Northern fur seals and northern elephant seals forego hauling grounds except when necessary for breeding or molting, and reside solely in offshore waters, Several cetacean species reside throughout the year within the SCB. However, populations are relatively small when compared with the migratory elements of the same species that utilize the SCB seasonally. Common species include common dolphin, Pacific white-sided dolphin, Northern right whale dolphin and long finned pilot whale.

A detailed discussion of marine mammals in the SCB can be found in the Center for Coast Marine Studies (1980) and the FEIS for the Proposed Southern California Lease Offering, April, 1984. Details on endangered species are tabulated in III.C.2.b.(6).

### (5) Coastal and Marine Birds

A variety of coastal and marine birds are associated with the Southern California Bight. Over 2.5 million seabirds may pass through or reside in this area. The various habitats available for coastal birds in southern California include: 1) sandy beaches, 2) rocky shores, 3) offshore rocks, and 4) wetlands (mainly sloughs and bays). Wetlands are a significant marine and shorebird habitat within the Southern California area. These areas provide important feeding and resting areas for migratory species. Since seabirds are awkward on land and, therefore, subject to predation, they usually nest on the islands in the SCB. Primary nesting areas are in areas free from human intrusion, island fox predation and where food resurces are plentiful. Several breeding sites have worldwide and regional importance. Santa Barbara Island has the largest Xantus Murrelet nesting colony in the world and the only U.S. nesting site for the black storm-petrel. The California population of Brown pelicans nest primarily on Anacapa Island.

### (6) Endangered and Threatened Species

The southern California planning area is utilized by several State and Federally listed Threatened and Endangered species which may be affected by proposed offshore lease sales and development (See Table III.C.2.b.(6). Those species most commonly listed for the southern California area include seven endangered whale species, three endangered and one threatened species of turtle, the threatened southern sea otter, the proposed Guadalupe Fur Seal, the endangered California Brown Pelican, American Peregrine Falcon, Southern Bald Eagle, California Least Tern, LightFooted Clapper Rail, and the Salt Marsh Bird's Beak. See section III.B.6 of the FEIS for Proposed Southern California Lease Offering, April, 1984 for a detailed discussion of the listed species and distribution for the southern Calfornia area.

### (7) Estuaries and Wetlands

Coastal embayments along the California coast in general are small in comparison to the east coast. This is particularly true of the southern California area.

Where, because of arid climate and rather recent geological setting, there is no large river entering the sea; consequently, most bays on the coast of southern California are small. Furthermore, the absence of a coastal plain in southern California has restricted the development of salt marsh to small areas bordering sheltered bays and lagoons. The major estuaries together with their area of habitat type are shown in Table III.C.4.b.(7)-1. Detailed coverage of the biological aspects of estuaries in southern California can be found in Ju-Shey Ho (1974), Bureau of Land Management (1975, 1978b, 1978c). There are many good references of estuaries, in general, and of California in particular, including Jones and Stokes (1980).

The great influx of residents to southern California during and following World War II, resulted in substantial alteration of the natural state of the southland. Nearly all of the bays and lagoons have been modified by the activities of man through construction of marinas and breakwaters, building of roads and railroads, dredging of channels, diversion of rivers, and use for waste disposal. In spite of these alterations to the original natural estuarine areas, many of the original species still occupy parts of most altered estuaries. Their abundances and the composition of many assemblages, however, may have changed. The small Santa Maria River, Santa Ynez River, Goleta Slough, Carpinteria Marsh and Tijuana Estuary, together with the larger Mugu Lagoon, Anaheim Bay, and Upper Newport Bay, are some of the few major embayments that still remain in a relatively unaltered condition.

### (8) Areas of Special Concern

There are four types of state designated areas of special concern which are of biological importance. They are: 1) ecological reserves, 2) marine life refuges, 3) reserves, and 4) area(s) of special biological significance (ASBS) shown on Table III.C.4.b.(7)-2. These are legally defined and controlled by the State of California. Ecological reserves and marine life refuges are very similar; however, there are more restrictions and controls in an ecological reserve. The purpose of the refuges and reserves is to reduce the abuse and waste of the State's tidepool resources by restricting general collecting of all animals living in tide pools and other areas between the high tide mark and 1,000 feet below the low tide mark.

ASBS are also designed to protect intertidal and shallow subtidal areas. They are areas containing biological communities of such extraordinary, even though unquantifiable, value that no acceptabe risk of change in their environments as a result of man's activities can be entertained.

From Point Conception to the U.S.-Mexican border, there are ten Ecological Reserves, ten Marine Life refuges/reserves, and thirteen Area(s) of Special Biological Significance. The areas are discussed more fully in BLM (1975).

TABLE III.C.4.b.(7)-1

## TYPES OF ESTUARIES OF ECOLOGICAL CONCERN IN SOUTHERN CALIFORNIA

| Area | Habitat Type in Acres |
|---|---|
| Santa Maria River | Marsh, 20; water, 6 |
| Santa Ynez River | Marsh, 44.5; water, 23 |
| Santa Barbara Channel | |
| Devereaux Ranch Lagoon | Marsh, 15; water, 30 |
| Goleta Point Marsh | Marsh, 25; water, 35 |
| Goleta Slough | Marsh, 260 |
| El Estero (Carpinteria Marsh) | Marsh, 150; mudflat, 35; water, 15 |
| Ventura River | Marsh, 5; water 5 |
| Santa Clara River | Marsh, 40; water, 20 |
| McGrath Lake | Marsh, 5; water, 15 |
| Mugu Lagoon | Marsh, 1420; mudflat, 500; water, 250 |
| TOTAL | Marsh, 1920; mudflat, 535; water, 370 |
| Inner Basins | |
| Malibu River | |
| Ballona Creek | 10 of original habitat |
| Anaheim Bay | Marsh, 480; mudflat, 40, water, 3701 |
| Bolsa Bay | (approximately 1,500 acres of degraded wetlands with potential for improvement)2 |
| Upper Newport Bay | Marsh, 200; mudflat, 650; water, 500 |
| Santa Margarita Lagoon | Wetlands (undifferentiated) 600 |

TABLE III.C.4.b.(7)-1 (cont.)

## TYPES OF ESTUARIES OF ECOLOGICAL CONCERN IN SOUTHERN CALIFORNIA

| Area | | Habitat Type in Acres |
|---|---|---|
| Agua Hedionda Lagoon | | Wetlands (undifferentiated but primarily water) 300 |
| Batiquitos Lagoon | | Wetlands (undifferentiated) 6003 |
| San Elijo Lagoon | | Wetlands (undifferentiated) 500 |
| Mission Bay | | Marsh, 20; water, 2,340 |
| San Diego River | | Wetlands (undifferentiated) 2504 |
| Famosa Slough | | Connected to San Diego River |
| San Diego Bay | | Marsh, 360; mudflat, 600; water, 11,000; salt ponds, 1,400 |
| Tijuana River | | Wetlands (undifferentiated) 400 |
| | TOTAL | Marsh, 1,060; mudflat, |
| 1,290; | | water, 14,210; salt pond, 1,400; wetlands (undifferentiated), 4,160 |

---

1Including harbor and tidal channels.

2Bolsa Bay not included acres of wetlands. Lower Newport Bay and Huntington Harbor are also excluded as these areas contain little or no marsh or mudflat habitat.

3From "Coastal Lagoons of San Diego County."

4Includes 150 acres of eel grass.

## TABLE III.C.4.b.(7)-2

## AREAS OF DEFINED BIOLOGICAL SIGNIFICANCE IN THE SOUTHERN CALIFORNIA BIGHT. ASBS - AREA(S) OF SPECIAL BIOLOGICAL SIGNIFICANCE

| | |
|---|---|
| Bolsa Chica Ecological Reserve | |
| Heisler Park Ecological Reserve | ASBS |
| Upper Newport Bay Ecological Reserve | |
| Buena Vista Lagoon Ecological Reserve | |
| San Diego - La Jolla Ecological Reserve | ASBS |
| San Miguel Island Ecological Reserve | ASBS |
| Anacapa Island Ecological Reserve | ASBS |
| Santa Barbara Island Ecological Reserve | ASBS |
| Abalone Cove Ecological Reserve - Lover's Point Reserve (Catalina Island) | |
| Farnsworth Bank Ecological Reserve (Catalina Island) | ASBS |
| Point Loma Reserve | |
| Point Fermin Marine Refuge | |
| Newport Beach Marine Life Refuge | ASBS |
| Irvine Coast Marine Life Refuge | ASBS |
| Laguna Beach Marine Life Refuge | |
| South Laguna Beach Marine Life Refuge | |
| Niguel Marine Life Refuge | |
| Dana Point Marine Life Refuge | |
| Doheny Beach Marine Life Refuge | |
| San Diego Marine Life Refuge | ASBS |
| Mugu Lagoon to Latigo Point | ASBS |
| Santa Rosa Island | ASBS |
| Santa Cruz Island | ASBS |
| San Nicolas Island | ASBS |
| Begg Rock | ASBS |
| Santa Catalina Island including the following subareas: | ASBS |
| Subarea 1 Isthmus | |
| Subarea 2 North end of Little Harbor to Ben Weston Point | |
| Subarea 3 Farnsworth Bank | |
| Subarea 4 Binnacle Rock to Jewfish Point | |
| San Clemente Island | ASBS |
| Seal Beach National Wildlife Refuge | U.S. Dept of Navy |
| Tijuana River National Estuary Sanctuary | NOAA |

### (9) Marine Sanctuaries

The Channel Islands National Marine Sanctuary is the only established marine sanctuary within the southern California area. The objectives of the marine sanctuary are to preserve a unique and strategically located ecosystem (intertidal, subtidal benthos, pinnipeds, seabirds, recreation, and cultural resources), to encourage scientific research, and to enhance public awareness of the sanctuary resources. The boundaries of this sanctuary are defined as the ocean area from the mean high tide line to a distance of 6 nm around San Miguel, Santa Rosa, Santa Cruz, Anacapa and Santa Barbara Islands. The islands themselves are not part of the sanctuary although they are a national park. The California Department of Fish and Game and the National Marine Fisheries Service are responsible for the regulation of fishing within the sanctuary boundaries.

For further information on the Channel Islands National Marine Sanctuary, see the following: FEIS for OCS Sale No. 68 (Bureau of Land Management, 1981), FEIS on the Proposed Channel Islands Marine Sanctuary (U.S. Department of Commerce, May 1980), the General Management Plan Channel Islands National Park (National Park Service, September 1980).

The Channel Island National Marine Sanctuary contains some highly productive waters and bottom communities, including an area of purple coral. Because of the high productivity, sanctuary waters are important for forage by the many important biological communities and species of the area. This site also contains highly productive kelp beds, commercially and recreationally valuable fish and shellfish, and several biogeographic transition zone species.

## c. Socioeconomic Environment

### (1) Employment and Demographic Conditions

The Southern California planning area encompasses six coastal counties in Southern California. These are the counties of San Luis Obispo, Santa Barbara, Ventura, Los Angeles, Orange and San Diego.

The Southern California area ranges from the heavily industrialized and populated counties of Los Angeles and Orange to the more sparsely populated and agricultural counties of San Luis Obispo and Santa Barbara and Ventura.

The region possesses similar economic characteristics in which manufacturing, services and wholesale-retail trade are the dominant industries and major sources of private employment. Tourism related employment occurs mainly in the trade and services sectors and is not reported separately.

The six counties in the study area account for 51 percent of the state's population. The majority of the population resides in the coastal areas.

Lack of affordable housing in Coastal Southern California places a limit to continued population growth within the study area. San Bernardino and

Riverside counties provide low cost housing alternatives to Los Angeles and Orange counties. Detailed information can be found in the FEISs for Proposed Southern California Lease Offering, April, 1984, section III.C.1 and for Proposed OCS Sale No. 73, Sections III.C.1 and 2.

### (2) Coastal Land Uses and Water Services

Southern California is the most heavily urbanized area in the state. More than 14 million persons, or approximately sixty percent of the State's population, lives in the greater Los Angels area. As a result this region supports a full mix of agricultural, industrial, commercial, residential, and military land uses. Much of the urban coastal regions are fully developed and possess little, if any, vacant land. The California Department of Water Resources projects that fifty percent of total anticipated population growth within the State will occur in Southern California.

Of the three California planning areas, Southern California is the only planning area with offshore oil and gas development and onshore facilities in support of offshore development. Existing onshore develpoment (supporting offshore activities) occurs from Port Hueneme in Ventura County North to Gaviota in Santa Barbara County. Onshore areas from Gaviota to Point Sal (also in Santa Barbara) are now experiencing oil and gas related development due to the development of new offshore fields.

This region is the driest of the three planning area. To meet water demand, 58% of net water use is met by either importing water from other regions or by overdrafting ground water supplies. The discussion which follows will be divided into two sections.

The Central Coast Hydrologic Study Area consists principally of the following four counties: Santa Cruz, Monterey, San Luis Obispo, and Santa Barbara. In these four counties 20% of the demand for water is being met by ground water overdraft. Further, the major use of water is for agricultural purposes (82%). Only 17% is used for urban uses, reflecting this sub-regions lack of urbanization. In 1980 the urban water shortage was 5,000 acre/feet. Water used to support energy production accounted for 0.6% of net water use.

The remaining portion of the Southern California planning area is covered in three hydrologic study areas. This subregion is the most heavily urbanized, and depends on importing 62% of it water. Unlike the Central Coast Hydrologic Study Area this subregion only meets 3% of its net water use by overdrafting ground water. Further, 72% of net water use is for urban uses. Energy production in the greater Los Angeles Area accounted for 0.6% of net water use. No water was used to support energy production in the San Diego area.

As with the other planning areas, urban areas with sewer service process their water in waste treatment facilities and rural areas utilize septic systems. Overall, the waste water system is operating within limits, but continued populatino growth is placing additional demand for increased capacity. In San Diego area the Point Loma plant is currently operating at capacity. Both the City of Los Angeles and the county of Los Angeles have applied for secondary treatment waivers from the Environmental Protection Agency and the California Water Quality Control Board.

The only water quality problem resulting from sewage discharges is occurring off the Mexican/U.S. border. Contaminated water from the City of Tijuana is drafting into U.S. waters and has resulted in the closing of 2.4 miles of beach on the U.S. side.

### (3) Commercial Fisheries

Southern California ports receive about 75 percent of the total landings of commercial marine fisheries in the state. In 1981, 70 percent of the value of these landings came from fish, mostly tunas, caught in waters not offshore California. The 1982 statewide catch was 315,000 metric tons (695 million pounds) and was valued at $241 million (U.S. Department of Commerce, 1983). Applying a multiplier factor of 3.1 (U.S. Water Resources Council, 1977) to include processing, transportation, marketing, and other support industries associated with the fishing makes the total value nearly $750 million. Major ports include San Diego, Terminal Island, San Pedro, Wilmington, Port Hueneme, Oxnard and Santa Barbara.

Besides pelagic tunas, major catches include northern anchovy, California barracuda, Pacific bonito, Pacific butterfish, white croaker, flying fishes, California halibut, jack and Pacific mackerels, rock fishes, white seabass, sharks, albacore tuna, yellowtail, rock crab, California spiny lobster, sea urchins, black, green, and pink abalones, and market squid. Lingcod, sablefish, salmons, soles, ridgeback and spot prawns, and red abalone are fairly important in the Santa Barbara area. The most common harvesting methods are trawling, trolling, seining, long-lining, gill netting, and diving. Commercial quantities of kelp (giant seaweed) are cut in the area. Other marine algas are also harvested.

Additionally, maricultural activities contribute to the local commercial production of marine life, though most such activities are still in the research and development phase. Cultered organisms include kelp, abalone, lobster, scallops, mussels, anchovy, Pacific sardine, Pacific mackeral, and striped bass.

A more detailed discussion of the industry is found in Section III.C.3 (pp 3-137 to 3-142a) of the FEIS for the Proposed Southern California Lease Offering, April 1984 and Leet and Cramer (1971).

### (4) Recreation and Tourism

The southern California coast is an important recreational asset to the residents of the State and to tourists. Along the coast, recreation is primarily water-oriented, both from an active participation, and from an aesthetic and passive aspect. There are numerous public and privately owned recreational sites which have direct access to the ocean. A complete listing of recreational sites is presented in POCS Technical Paper No. 81-5

(The Granville Corporation, 1981). Access sites to the beaches have been listed and described for the California Coast by the California Coastal Commission in the California Coastal Access Guide (1981).

The major recreational activities of the southern California coast are sightseeing, beachcombing, picnicking, boating, swimming, wading, sunbathing, diving, surfing, and sportfishing. The economic value of recreation in southern California is in excess of $1,795 million (based on the Granville Corporation, 1981). This value only considers the expenditure involved in furnishing the activity but gives the magnitude of the recreation industry in Southern California.

Tourism is one of the major industries in California, and has been recognized as an important element in the regional economy.

According to the Southern California Visitors Council, tourism in southern California supported approximately one million jobs and had an economic value of approximately $7.3 billion in 1978.

Sportfishing is an important recreational activity throughout southern California. Five fishing methods predominate in the southern California ocean sportfishery: shore, pier, skiff, party boat (commercial passenger fishing vessel), and skin diving (including SCUBA).

The distribution of fishing and the number of participation days for the California Coast are given in POCS Technical Paper No. 81-5 (The Granville Corporation, 1981). The economic value of sportfishing can be approximated using the data presented in the report by The Granville Corporation (1981). This places the value in excess of $159 million in 1980, but does not include the value to the fishermen of the actual catch. The southern California coastline is extremely diverse in its variety of landforms and cultural modifications, and contributes to the economic success of the tourist industry by attracting vacationers to the shoreline.

### (5) Cultural Resources

The southern California coastal area contains numerous archaeological sites, most of which represent Native American resources. The offshore region of California is believed to contain numerous cultural resources. Types of submerged resources are aboriginal remains, and sunken ships and aircraft. The field of marine archaeology in California has developed only recently. Thus far, most marine prehistoric work has occurred in the San Diego and the Santa Barbara Channel areas.

More detail can be found in the Final Environmental Impact Statements for OCS Lease Sale Nos. 35, 48, 68, 73, and Proposed Southern California Lease Offering, April, 1984 (BLM, 1975, 1979, 1981, and MMS, 1983, 1984).

### (6) Marine Vessel Traffic

Commerical and military vessel traffic offshore Southern California is routed through a system of Traffic Separation Schemes and Port Access

READEX FICHE

Routes that are established by the U.S. Coast Guard. A Traffic Separation Scheme (TSS) is an internationally recognized vessel routing measure which serves to provide a separation of opposing flows of vessel traffic. A Port Access Route (PAR) generally consists of a Precautionary Area and associated TSSs. Precautionary Areas are defined limits where vessels must navigate with particular caution.

The Eleventh Coast Guard District has proposed to reconfigure the present approaches to the Los Angeles/Long Beach Precautionary Area in order to reduce vessel routing conflicts. Presently, two Traffic Separation Schemes (TSS) (consisting of a northbound lane, a southbound lane, and a separation zone between the two lanes) feed into this harbor region: 1) the Santa Barbara Channel TSS which routes shipping traffic to and away from the Santa Barbara Channel area; and 2) the Gulf of Santa Catalina TSS which routes traffic into and away from the harbor region. The proposed reconfigurations to the Precautionary Area are as follows: a) move the northbound shipping traffic lane of the Santa Barbara TSS one nautical mile south; b) move the southbound lane of the Santa Barbara TSS one nautical mile south; c) reduce a portion of the separation zone of the Santa Barbara TSS from two miles to one mile; and d) alteration of the Precautionary Area.

Additionally, the Eleventh Coast Guard district has proposed the following recommendations for vessel traffic routing in the Santa Maria Basin area: 1) the existing TSS from Point Fermin to Pt. Conception is recommended to be extended in a north-westerly direction; 2) a new navigation fairway system would extend northward from a new Precautionary Area (described in 3, below) off Pt. Conception to latitude 35°00'N (where it would meet with the Twelfth District's routing scheme); and 3) a new Precautionary Area with a four nautical mile radius would connect the extension of the existing, generally east-west TSS with the new generally north-west fairway system. It would also serve as a junction for transpacific traffic and for traffic merging with the Trans-Alaskan Pipeline System (TAPS) Tanker Route.

See Table III.C.4.c.(6)-1 for a summary of major port activity levels.

### (7) Military Uses

Essentially all of the southern California OCS is directly used for various military operations except for the Santa Barbara Channel (see Figure III.C.4.a.(6)-1). The key military facilities involved include the Western Space and Missile Center at Vandenberg A.F.B., the Pacific Missile Test Center at Point Mugu, the Naval Shipboard Electronic Systems Evaluation Facility at Long Beach, the Marine Corps at Camp Pendleton and at Santa Barbara Island, the San Clemente Island training, firing, and buffer zone (25 nautical miles around the island to protect existing ranges and operations), and the Fleet Area Control and Surveillance Facility at San Diego. More specific information on the various military operations, including coordinates of the operating areas and frequency of missions/usage, is included in the FEIS for OCS Lease Sale 73 (MMS, 1983) and in the FEIS for Proposed Southern California Lease Offering in Chapter

## Table III.C.4.c.(6)-1

## Marine Vessel Traffic - Major Ports of Southern California

Source: U.S. Department of the Army, Corps of Engineers. Waterborne Commerce of the United States, Calendar Year 1982, Part. 4. July 1984.

| Port | Total Number of Vessel Trips (Includes self and non-self propelled, excludes domestic fishing craft) | | Total Freight Traffic (Short Tons) |
|---|---|---|---|
| | Inbound | Outbound | |
| San Diego, CA | 1,551 | 1,537 | 2,398,103 |
| Long Beach, CA | 10,390 | 10,377 | 42,010,254 |
| Los Angeles, CA | 9,430 | 9,428 | 33,099,929 |
| Port Hueneme, CA | 1,703 | 1,680 | 338,719 |
| Ellwood, CA | 6,859 | 6,858 | 261,985 |
| Encina, CA | 22 | 20 | 772,667 |
| Ventura, CA | 78 | 78 | 620,245 |

V in the letter from the Department of the Navy, Deputy Assistant Secretary (Installations and Facilities). The activities currently taking place include live ordinance and missile firing and testing, flight and air combat training, surface and submarine fleet maneuvers and training, aircraft testing, spaceshuttle flights, electronic systems testing, antenna radiation patterns, ship acoustic signature measurements, electronic calibrations, mine sweeping operations, small arms firings, sonar exercises, torpedo firing, helicopter operations, aircraft carrier operations, simulated and live bombing and rocket firing, amphibious vehicle training and assault operations, and antisubmarine warfare (ASW).

### (8) Native Subsistence

The coastal portions of the southern California area contains several localities of concern to various resident contemporary ethnic groups.

There are numerous geographic landmarks and areas that are of special concern to Native Americans because they were traditionally used by their ancestors. Many of these places are still being used in traditional ways.

Subsistence gathering continues today both inland and on the coast. The intertidal zone is especially important to coastal dwellers. Although not well documented, family-gathered foodstuffs may account for up to 25 percent of total subsistence for some Native American families. Gathering for ceremonial purposes (traditional medicines, herbs, and teas) has been primarily documented by BLM and others.

Both subsistence and ceremonial gathering has been reduced in recent years because of a decrease in the supply of traditional plant and animal foods.

Although the intertidal zone is controlled by the State, beach access in many areas is restricted by private property owners.

The intertidal zone of southern California is also the object of intensive gathering activities by members of various ethnic groups, including Mexican, Filipino, Japanese, Korean, Vietnamese, Cambodian and Hawaiian. This is due to the traditional food sources of these groups being heavily dependent upon the intertidal gathering practices in their ethnic backgrounds.

## D. Alaska Region

### 1. Gulf of Alaska Planning Area

#### a. Physical Environment

##### (1) Geology

Interpretation from seismic data indicate that the continental margin of the Gulf of Alaska is geologically complex with different structural styles in southeast Alaska, Yakutat, Cape Yakataga, and the Middleton Island areas.

In the southeastern segment, the acoustic basement is near the surface over much of the shelf; and rocks forming the acoustic basement probably are similar to Paleozoic and Mesozoic rocks exposed in the nearby southeastern Alaska islands. A sedimentary sequence about 2 kilometers or more thick is present locally beneath the outer shelf, and beneath the continental slope and the base of the slope. Folds and faults within this area are most likely associated with the extension of splays of the Queen Charlotte-Fairweather fault system.

The rocks that underlie the continental slope of the Yakutat segment are of late Cretaceous to middle Tertiary in age.

Three major structural features can be found in the Yakutat area: (1) a large structural high centered on Fairweather Ground; (2) an area off the Dangerous River where the acoustic basement shallows abruptly; and (3) two sub-basins that are separated by the shallow basement off Dangerous River (Bruno, 1982).

The Cape Yakataga segment is characterized by numerous broad folds and associated thrust faults beneath the continental shelf and slope. The trend is generally in a northeastward-to-eastward direction. Deformation is most severe in the northern part of the shelf and onshore. The structures identified on seismic data are limited to strata of late Cenozoic age. The extension of those structures into the underlying early to middle Tertiary strata is inferred.

Structures on the Middleton segment include tightly folded and extensively faulted anticlines and a shelf-edge structural high on which Middleton Island is located. Paleogene rocks underlie much of the area.

##### (2) Geologic Hazards

Table III.D.1.a.(2)1. contains the geologic hazards by planning area. The table and discussion below apply to all planning areas and will not be repeated in subsequent descriptions. The potential severity of each hazard shown in Table III.D.1.a.(2)1. varies with time, location and type of activity. The measures that can be taken to lessen the effects of the hazards include (1) scheduling activities to minimize exposure to hazards; (2)

Table III.D.1.a.(2).1
Geologic Hazards of the Alaska OCS Region

| Geologic Hazard | REGIONS | | | | | |
|---|---|---|---|---|---|---|
| | Gulf of Alaska | Kodiak | Cook Inlet | Shumagin | North Aleutian Basin | St. George Basin |
| Sea Ice | | | X | | X | X |
| Ice Gouging of the Seafloor | | | | | | |
| Over Ice Flooding | | | | | | |
| Ice-Induced Current and Strudel Scouring | | | | | | |
| Subsea Permafrost | | | | | | |
| Natural Gas Hydrates | | | | | | |
| Storm Surges | | | | | | |
| Current Sediment Transport and Scour | | | | | | |
| Coastal Erosion | | | | | | |
| Migrating Barrier Islands | | | | | | |
| Migrating Shoals | | | | | | |
| Sandwave Migration | | | | | | |

## Table III.D.1.a.(2).1.
## Geologic Hazards of the Alaska OCS Region

| Geologic Hazard | REGIONS | | | | | |
|---|---|---|---|---|---|---|
| | Gulf of Alaska | Kodiak | Cook Inlet | Shumagin | North Aleutian Basin | St. George Basin |
| Sediment Slumping Near The Shelf Break and on the Slope | X | X | X | ? | | X |
| Liquefaction of Seafloor Sediments | X | X | | ? | | |
| Gas-Charged Sediments | X | X | X | ? | X | X |
| Thermogenic Gas | X | | | | | |
| Faults | X | X | X | X | X | X |
| Earthquakes | X | X | X | X | X | X |
| Volcanism | | X | X | X | | X |
| Superstructure Icing | | X | | | | X |
| Tsunamis | X | X | X | X | X | X |
| Seiches | X | X | X | X | | X |

Table III.D.1.a.(2).1
Geologic Hazards of the Alaska OCS Region

| Geologic Hazard | REGION | | | | |
|---|---|---|---|---|---|
| | Navarin Basin | Norton Basin | Hope Basin | Chukchi Sea | Beaufort Sea |
| Sea Ice | X | X | X | X | X |
| Ice Gouging of the Seafloor | | X | X | X | X |
| Over Ice Flooding | | X | | | X |
| Ice-Induced Current and Strudel Scouring | | X | | | X |
| Subsea Permafrost | | | | X | X |
| Natural Gas Hydrates | | | | X | X |
| Storm Surges | | X | X | X | X |
| Current Sediment Transport and Scour | X | X | | X | |
| Coastal Erosion | | X | | X | X |
| Migrating Barrier Islands | | | | | X |
| Migrating Shoals | | X | | | X |
| Sandwave Migration | X | X | | | |

## Table III.D.1.a.(2).1 (cont'd)
## Geologic Hazards of the Alaska OCS Region

| Geologic Hazard | Navarin Basin | REGION Norton Basin | Hope Basin | Chukchi Sea | Beaufort Sea |
|---|---|---|---|---|---|
| Sediment Slumping Near The Shelf Break and on the Slope | X | | | X | X |
| Liquefaction of Seafloor Sediments | | X | | | |
| Gas-Charged Sediments | X | X | | | X |
| Thermogenic Gas | | X | | | |
| Faults | X | X | | X | X |
| Earthquakes | | X | | | X |
| Volcanism | | | | | |
| Superstructure Icing | X | X | | | |
| Tsunamic | | | | | |
| Seiches | | | | | |

Source:

locating facilities away from known hazards; and (3) designing facilities to withstand the effects of the hazards. Geological hazards such as volcanism, tsunamis, and seiches could be a threat to any oil and gas operations taking place in coastal areas.

The Hope planning area was not included in the March 1980-February 1985 proposed Five-Year OCS Oil and Gas Lease Sale Schedule; thus, the geologic hazards of that area has not been characterized as extensively as they have in those planning areas that were included in that Five-Year Lease Schedule. The indication of potential hazards in the Hope Basin is based, in part, on the presence of similar hazards in adjacent planning areas.

### (3) Non Petroleum Mineral Resources

There are no known economically recoverable non petroleum mineral resources in this planning area. This is true of all planning areas except the Norton and Beaufort areas. Their resources are discussed in the area descriptions.

### (4) Physical Oceanography

In the Gulf of Alaska, the maximum significant wave height equals about 21.5 meters (70 ft.), however, extreme wave heights can reach about 38 meters (126 ft). Water depths are usually great, ranging from approximately 30 meters to over 3500 meters. Even during the most severe winters, oceanographic conditions preclude the formation of sea ice in the Gulf of Alaska. Super-structure icing, however, is common during winter months. The general circulation is a cyclonic gyre formed by the east-flowing Subarctic Current (located about 48°N) and the Alaska Current.

### (5) Water Quality

Water quality of the Gulf of Alaska and all other planning areas is considered pristine on the basis of limited trace metal and hydrocarbon analyses. Relevant trace metals occur in concentrations one or more orders of magnitude below applicable water quality criteria of the Environmental Protection Agency.

### (6) Air Quality

Existing air quality in the Gulf of Alaska is considered pristine. The EPA has prepared emissions inventory and ambient air quality estimates for areas in Alaska with relative low populations, based on general emission factor relationships with local economic base and demographic data.

Using this method of air quality analysis, the EPA considers the Gulf of Alaska to be in compliance with Federal ambient air quality standards. It is most likely that the area's air quality is far superior to the national and state standards. However, no air monitoring has been performed in the Gulf of Alaska.

### (7) Climate

The climate of the Gulf of Alaska is classified as marine. Mild winters, cool summers, heavy precipitation, and strong winds are characteristic conditions. Mean air temperature ranges from approximately 1.0 degrees C in January to 13.0 degrees C in August, averaging 6.2 degrees C. Scalar mean winds average 17 knots, peaking at 22 knots in December. Mean wind speed averages 20 knots or more for four months of the year.

### b. Biological Resources

### (1) Plankton

### (a) Phytoplankton

Nannoplankton (phytoplankton smaller than 35u or 10u, depending on the author) are the dominant photosynthetic organisms in the Gulf waters. It has been found that the large, chain-forming *Chaetoceros concavicornis* and *Thalassiosira aestivalis* reached moderately high concentrations during the spring and summer. The large diatoms grow most vigorously at high nutrient levels and so generally reach their maximum concentrations during the spring, when nutrient levels are optimum. As nutrient levels are depleted in the summer, the large diatom species are less able to compete, and populations of microflagellates and dinoflagellates (which can grow at low nutrient concentrations) increase. (Dept. of Commerce 1980a)

### (b) Zooplankton

Zooplankton populations in the Gulf of Alaska appear to reach maximum numbers from late May through mid-July. Copepods dominated zooplankton collections from the shelf and from Prince William Sound. The most abundant copecods were the small surface-living *Acartia longiremis*, *Oithona similis*, and *Pseudocalanus* spp. These species breed following intensive feeding, with the size of their brood depending on the amount of food consumed. This means that the period of maximum breeding activity for these species does not occur until phytoplankton activity is at a maximum. Hatching of eggs occurs some weeks later, hence the lag between phytoplankton and zooplankton peaks.

Common copepods found in the deeper waters (though possibly migrating toward the surface early in the year) were *Calanus cristatus*, *C. marshallae*, and *C. plumchrus*. Five species of euphausiids *Euphausia pacifica*, *Thysanoessa inermis*, *T. longipes*, *T. raschii*, and *T. spinifera*) were also found but in much lesser numbers than the copepods. (Dept. of Commerce 1980a)

### (2) Fish Resources

The Gulf of Alaska has about 20 commercial groundfish (bottomfish, whitefish) species, 7 species of shellfish, 6 species of mollusks, five species of salmon, and the Pacific herring. Pollock comprise most of the groundfish catch from this area at this time, tanner crab is the major shellfish, the razor clam the predominant mollusk, and pink salmon, the most widely harvested salmonid. Pacific herring, significant forage fishes, also support spring commercial fisheries. The benthic groundfish, shellfish, and mollusks, in most instances have pelagic life stages during development and some perform seasonal migrations to shallower depths; the salmonids and herring are pelagic and they are in coastal areas during their spawning migrations. Further information regarding species and habitat specific usage and distribution is available in the Cook Inlet/Gulf of Alaska (Sale 88) FEIS.

### (3) Marine Mammals

Minke and killer whales and the Pacific white-sided dolphin are seasonally abundant in the Gulf of Alaska. The north Pacific minke whale population (including the Gulf of Alaska) is estimated at 100,000 individuals. Minke whales are most abundant in the summer over the continental shelf (particularly in shallow, nearshore waters) when they are concentrated in Prince William Sound and in the northeastern Gulf including Yakutat Bay. They are scarce in the area in the fall, and leave the region by October.

Approximately 3,000 killer whales are estimated for the north Pacific population, including the Gulf of Alaska. They are also abundant in shallow waters (less than 200 meters deep) in the summer, when they are concentrated in Prince William Sound and Southeast Alaska, and more scarce in the Gulf in the fall. Their movements are believed to be related in part to nearshore migrations of common pelagic prey species (e.g., salmon). Similarly, abundance of the Pacific white-sided dolphin (generally distribured over the continental slope in waters from 200 to 2,000 meters deep) varies seasonally from rare in the winter to most abundant in the summer when they concentrate in areas of high fish abundance (e.g., Fairweather Grounds). Other nonendangered cetaceans including Risso's dolphin, short-finned pilot whale, northern right whale dolphin, the north Pacific giant bottlenose whale, goosebeak whale, and Bering Sea beaked whale are also observed occasionally in the planning area.

### (4) Coastal Marine Birds

At least 2.1 million seabirds (especially storm-petrels, cormorants, gulls, terns and murres) reside in Gulf of Alaska nesting colonies during the breeding season (April-October). A majority of these are concentrated on Forrester Island (1.02 million) and St. Lazaria Island (404,000) in southeast Alaska, and on Middleton Island (177,000). Except for the northeastern gulf area, smaller colonies are found along the entire coastline (Sowls et al., 1978). Nocturnal species (e.g., storm-petrels) probably nest in much larger numbers than presently recorded. In this and other southern Alaska coastal regions, breeding seabird species are far outnumbered by the 9-10 million non-breeding southern-hemisphere shearwaters which spend the summer in Alaskan waters.

Most bays and other coastal tidelands provide important habitat for waterfowl and shorebirds, especially during migration periods. Of outstanding importance is the Copper River Delta and adjacent bays and inlets. Here, more than 20 million migrating waterfowl and shorebirds stop each spring;

densities of up to 849 birds/sq.km.(100,000/sq.km. in isolated observations) have been recorded (Isleib, 1979; Senner, 1979). The Copper River Delta and vicinity also comprise the region's most important waterfowl nesting area; most dusky Canada geese nest here.

Further information concerning species-specific habitat usage, distribution of lesser seabird colonies, waterfowl nesting areas, seasonal distribution and abundance (density) and annual cycle characteristics is available in the Cook Inlet/Gulf of Alaska (Sale 88) FEIS.

### (5) Endangered and Threatened Species

#### (a) Whales

The gray, blue, sei, fin, right, humpback and sperm whales are present in the of Alaska planning area. The gray whale most commonly occurs in this area during their spring and fall migrations (March through June, and October through December). Some whales may be present all summer in the outer areas of Prince William Sound. Gray whales generally migrate within a few miles of shore and have been observed feeding in localized areas between Yakutat and the Kenai Peninsula. Blue whales are mostly summer visitors occurring here between May and September. They inhabit the more oceanic waters and are most likely to be found between 130°-140° W longitude and north of 50° N latitude off southeast Alaska. Historically, blue whales were abundant offshore of the Alexander Archipelago. Fin whales begin entering the Gulf of Alaska planning area in March and summer concentrations (May-September) occur from 144°-150° W longitude and 56°-59° N latitude. Fall migrations begin in October but a few whales may overwinter in this area. Sei and fin whales are considered an offshore continental shelf inhabitant. Migration routes, timing and locations of fin and sei whales are similar. The right whale was "historically abundant" in the Gulf of Alaska but now may be biologically extinct. Right whales were present from May through August with increased members in June or July in coastal waters and near land masses. No right whales have been positively or tentatively identified in the Gulf of Alaska since 1980. Sperm whales are characteristically located in deep waters near the continental slope and off the shelf. They are widely distributed in this area in the spring and summer. Mature males migrate to more northern latitudes but females and immature animals seldom migrate north of 50° N latitude (10°C isotherm). Humpback whales migrate into the area beginning in March from wintering areas in Hawaii and Mexico. They concentrate during the summer in the Prince William Sound and the Stephens Passage/Frederick Sound feeding areas inshore of OCS waters. The fall migration may start as early as September.

#### (b) Birds and Plants

Three subspecies of the peregrine falcon occur in Alaska and may be found adjacent to the planning area. The unlisted Peale's peregrine falcon nests in coastal areas from Alaska's southeast through the Aleutian Islands. The endangered American peregrine falcon nests in the interior boreal forest region, and the threatened arctic peregrine, nests in the tundra region along Alaska's northwest coastline. They may occasionally occur adjacent to the planning area during the winter period or migration (September to April). However, there is no data to indicate that the arctic or American peregrine falcons overwinter near the area. Some scattered nesting of the arctic peregrin may also occur near the planning area (USDOI, FWS, 1982).

The endangered short-tailed albatross is now known to nest only on the Japanese island of Torishima. Once abundant and widespread in the North Pacific, the species was reduced to near extinction by plummage hunting. Currently the population is slowly increasing and now numbers about 250 individuals (DeGange, 1981). The short-tailed albatross was historically common in the Gulf of Alaska, but is now only occasionally seen in Alaskan waters.

There are no plant species listed as threatened or endangerd adjacent to the planning area. The FWS list of Alaskan plant species considered as candidates for Federal listing is currently undergoing revision. The current list includes the following species which occur adjacent to the Gulf of Alaska planning area: *Poa eyerdamii*, *P. merrilliana*, *P. norbergii*, and *Puccinellia triflora* (alkali grass).

### c. Socioeconomic Environment

#### (1) Employment and Demographic Conditions

Because Alaska has a small population and that is concentrated in 3 or 4 centers, the following is a brief discussion of the overall picture of Alaskan employment and demographics. The State of Alaska has over 500,000 inhabitants, with the majority of them living in the Anchorage-Matanuska-Susitna Region. Oil and gas development has been the primary economic force in the state for the last quarter-century. Development started with the discovery of the Swanson River Field in 1957 and expanded enormously with the discovery of Prudhoe Bay. The revenue from taxes on oil and gas production and facilities is the major source of income to the state government. Most of the construction and growth in the state during the last quarter-century can be attributed directly or indirectly to oil and gas resources. The first offshore commercial oil and gas resource was recently discovered off Seal Island in the Beaufort Sea Planning Area. The Gulf of Alaska and Cook Inlet Planning Areas are the most explored federal offshore areas in the state, with 23 dry holes and no commercial finds to date in either area. The remaining planning areas in the state are in the first stages of exploration.

Most of the economic effects that have developed from past oil- and gas-related efforts have occurred in the communities of Anchorage, Fairbanks, and Kenai. The Trans Alaska Pipeline System (TAPS) terminal in Valdez is responsible for most of the economic growth in that community. The North Slope Borough (NSB) has benefited from the Prudhoe Bay oil and gas developments, by taxing the facilities and resources and using the revenues to build community facilities and to provide goods and services to the local inhabitants, primarily Alaskan natives.

The ability of state and local governments to generate revenues from the development of offshore oil and gas resources is very limited, since most of the development is beyond the taxation boundaries, and only the onshore portions of OCS developments will currently provide any additional tax revenues. Revenue sharing legislation that would return a portion of the federal offshore revenue to the State and local governments has been proposed, but its effects cannot be estimated.

The population growth rate in Alaska, 2.88% annually from 1970 to 1980, has been very high since 1960, compared with the national average of 0.9 for the same period. Like the nation, the median age for Alaska increased from 22.9 in 1970 to 26.1 in 1980, however it is still below the national average of 30. In 1980, 53 percent of the State's population was male. Whites comprise 77 percent of the population of the State, with a higher concentration of whites in the urban areas. Native people; American Indians, Eskimo, and Aleut comprise 16 percent of the population, with the highest concentrations being in the villages and rural communities.

Although TAPS was completed in 1978 and Prudhoe Bay was in full production by 1980, the growth rate for the period April 1, 1980 to July 1, 1983 was higher than the rate for the previous decade in all communities except Valdez. (See Table III.D.1.c.(1)-1.). In fact, the absolute growth in the State during the last 3 years is greater than that realized for the decade of 1970 to 1980. Although the economic forces in the State have been very large and positive, unemployment in the area has remained high, because of the large influx of nonresidents to the area. Many of the jobs in the State are highly seasonal, including employment in construction, fishing and fish processing, recreation and tourism, and mining. Peak unemployment normally occurs during the winter months. Government, including Federal, State, and local, is the largest employment sector in the State followed by the (2) retail trade sector, (3) service sector, (4) transportation, communication, and utility sector, (5) construction sector, (6) mining sector, which includes part of the oil and gas industry, (7) finance, insurance and real estate sector, and last (8) the manufacturing sector. Fishing and agriculture are excluded from the previous analysis, since they are usually small owner operated firms, however, fishing is a key industry in the State. While direct employment in the oil and gas industry is only a portion of the jobs in the mining sector, many of the jobs in the other sectors are directly or indirectly attributable to the exploration, development, processing, and transportation of oil and gas in the State.

The municipality of Anchorage and the Matanuska-Susitna Borough is the population center of the State with about 256,919 inhabitants, 50.3-percent of the State's population on July 1, 1983. Anchorage is the service distribution center for the oil and gas industry, and the center for air and marine transportation. Most large companies that operate in the State have offices in Anchorage, including the oil and gas industry. Fairbanks, the second largest city in the State, is the commercial center for interior Alaska with a population of about 71,326 on July 1, 1983. (See Table III.D.1.c.(1)-1). The only railroad in the State connects the two communities, as well as a port at Seward. The third population center in the State is Kenai, which houses about 7-percent of the State's population with

Table III.D.1.c.(1)-1

## POPULATION CHARACTERISTICS AND TRENDS

| | April 1 1970 POPULATION | April 1 1980 POPULATION | July 1 1983 POPULATION | 1970 to 1980 ANNUAL GROWTH RATE | 1980 to 1983 ANNUAL GROWTH RATE | % CHANGE 1970 to 1980 | % CHANGE 1980 to 1983 |
|---|---|---|---|---|---|---|---|
| Aleutian Islands | 7,834 | 7,768 | 8,496 | -0.08% | 2.69% | -0.84% | 9.37% |
| Anchorage Borough | 126,385 | 174,431 | 227,070 | 3.27% | 7.94% | 38.02% | 30.18% |
| Bethel/Wade Hampton | 12,834 | 15,664 | 17,526 | 2.01% | 3.37% | 22.05% | 11.89% |
| Bristol Bay Borough | 1,147 | 1,094 | 1,275 | -0.47% | 4.60% | -4.62% | 16.54% |
| Dillingham | 3,872 | 4,616 | 5,623 | 1.77% | 5.93% | 19.21% | 21.82% |
| Fairbanks | 50,172 | 59,659 | 71,326 | 1.75% | 5.37% | 18.91% | 19.56% |
| Juneau/Sitka | 19,629 | 27,331 | 34,158 | 3.37% | 6.71% | 39.24% | 24.98% |
| Ketchikan/Prince of Wales | 13,823 | 15,138 | 18,005 | 0.91% | 5.21% | 9.51% | 18.94% |
| Kenai | 16,586 | 25,282 | 34,890 | 4.31% | 9.70% | 52.43% | 38.00% |
| Kobuk C.A. | 4,048 | 4,831 | 5,759 | 1.78% | 5.28% | 19.34% | 19.21% |
| Kodiak Island | 9,409 | 9,939 | 12,896 | 0.55% | 7.84% | 5.63% | 29.75% |
| Matanuska-Susitna | 6,509 | 17,816 | 29,849 | 10.59% | 15.58% | 173.71% | 67.54% |
| Nome | 5,749 | 6,537 | 7,661 | 1.29% | 4.77% | 13.71% | 17.19% |
| North Slope Borough | 3,451 | 4,199 | 5,168 | 1.98% | 6.25% | 21.67% | 23.08% |
| Skagway/Yakutat/Haines | 4,193 | 5,158 | 5,626 | 2.09% | 2.61% | 23.01% | 9.07% |
| Valdez/Cordova | 4,977 | 8,348 | 9,722 | 5.31% | 4.58% | 67.73% | 16.46% |
| Wrangell/Petersburg | 4,920 | 6,167 | 6,869 | 2.28% | 3.24% | 25.35% | 11.38% |
| Yukon-Koyukuk | 7,045 | 7,873 | 8,635 | 1.12% | 2.77% | 11.75% | 9.68% |
| Alaska State Total | 302,583 | 401,851 | 510,554 | 2.88% | 7.20% | 32.81% | 27.05% |

Source: Alaska Department of Labor, Alaska Planning Information, Jan 1984 Alaska Department of Labor, Neal Fried, August 27, 1984 about 34,890 people on July 1, 1983. Kenai has the State's only hydrocarbon processing facilities, and many of the oil and gas firms and support companies have offices and supply facilities in Kenai.

The average per capita income for the State in 1980 was $12,759 and led the nation. Per capita income for 1980 ranged from a low of $5,748 in Kuskokwim to a high of $15,732 in Juneau. With the exception of the Barrow-North Slope Borough and Ketchikan, the rural communities have per capita personal income levels lower than the State level. However, the 1980 census did not consider subsistence activities and the value of the products raised in the home.

In the smaller communities and villages, natives, American Indian, Eskimo, and Aleut, are the predominant race, with the white population comprising a small to negligible percent. The number of whites residing in the smaller communities and villages increases in the summer months during the construction period.

Currently, the Prudhoe Bay and Kaparuak fields in the North Slope Borough are the only enclave developments associated with oil and gas in the State. Aerial and marine support for exploration has occurred from the communities of Yakuatat, Nome, Dutch Harbor, and St. Paul for OCS related exploration, but the social and economic effects to the communities has been minimal.

Most communities within the Gulf of Alaska are coastal and port communities. With the exception of Valdez, fishing and fish processing has been and continues to be the primary industry in this subregion (Munger, 1972). Since the completion of the Trans-Alaska Pipeline System (TAPS), Valdez has become an integral part of the movement of North Slope oil to refineries in the lower 48 states.

Although commercial fishing is the primary industry in the Gulf of Alaska subregion, sport fishing, tourism, and recreation are growing in economic and employment importance.

No known petroleum reserves have been discovered in this subregion, although three offshore lease sales have been held and 12 wells have been drilled on offshore leased tracts.

Total population of the area is about 22,300 with Sitkin, Valdez, Cordova and Yakutat the largest towns. Growth rate for the area is about 3% per year.

Additional background and information concerning the Gulf of Alaska region may be found in the Northern Gulf of Alaska FEIS (USDOI, June 1975) and the Eastern Gulf of Alaska FEIS (USDOI, March 1980). (These EIS's are incorporated by reference.)

### (2) Coastal Land Uses

The majority of land adjacent to the Gulf of Alaska Planning Area is under federal and State of Alaska ownership. Major federal land holdings include the Kenai Fjords, Wrangell-Saint Elias, and Glacier Bay National Parks, the Chugach and Tongass National Forests, and three national wildlife refuges (Forrester Island NWR, Hazy Islands NWR, St. Lazaria Island NWR).

State lands adjacent to the Gulf of Alaska Planning area extends from Cape Suckling to Icy Bay. This area is the most productive forest land in state ownership and as a result has been dedicated to long-term forest management. Most forestry activity has occurred in the Yakataga area. The 1983 Statewide Natural Resources Plan has identified forestry as the primary use and principal purpose of management on these lands. Secondary uses include habitat, recreation, and coal development. The major communities adjacent to the planning area include Seward, Cordova, Yakutat, and Sitka.

### (3) Commercial Fisheries

Using 1980 statistics, the Gulf of Alaska provided 8.2 percent or 406,719 metric tons (mt) of the total domestic and foreign fisheries harvest in U.S. waters. Of the total harvest taken by the foreign vessels in all U.S. waters, approximately 14 percent (223,401 mt) was landed in the Gulf of Alaska. The Gulf of Alaska also accounted for 40 percent (183,318 mt) of the total Alaska catch by U.S. fishermen, dominated by salmon and shellfish landings. These catches of fish and shellfish from the Gulf of Alaska had an estimated harvest value of over $225 million.

About half of the annual regional fisheries harvest is taken by U.S. nationals. The domestic fisheries take place mainly in the coastal waters on the continental shelf, including the many bays and inlets that border the Gulf. Currently, a number of exclusively domestic fisheries exist in the Gulf of Alaska: Dungeness crab, king crab, tanner crab, shrimp, scallops, salmon, herring, and halibut. Eash fishery has its own set of regulations. The Alaska domestic fishery continues to be focused on high-value species (salmon, crab, and shrimp), although American fishermen are harvesting increasing amounts of the vast groundfish resources of the region.

Gulf of Alaska groundfish resources are among the most productive in the world. Alaska polluck, cod, rockfish and flounder comprise a very large biomass that is available for harvest by American fishermen.

Foreign fisheries in the Gulf of Alaska are confined to groundfish, primarily polluck, turbot, cod, rockfish, and sablefish by the Magnuson Fishery Conservation and Management Act of 1976 (MFMCA).

### (4) Recreation and Tourism

Recreational resources (fishing, hunting, hiking, sightseeing) are abundant in the area, and the regions that comprise the area vary in recreational and tourism values such as, property values, visual quality, and number of people living in the area. Recreational property values are high for remote parcels, visual quality of the landscape is superior, the resident populations are low, and the recreationist need only travel a few miles out of the largest cities to be in areas where landform, vegetation, water, color, distinctiveness and contrast are all of the highest quality.

### (5) Archaeological Resources

Approximately 1,000 onshore archaeological resource sites in the planning area have been listed on State records. Most of these lie next to the shore and consist of old subsistence resource gathering sites. Many of these are listed as National Register Sites. Offshore there are approximately 300 shipwrecks. With some exceptions, the sites of most of these shipwrecks are within the 3-mile zone; the best-preserved are likely to be found on the outer continental shelf, because waves cannot break up ships at depths beyond the 3-mile zone. One of these ships, the "Ameria" wrecked in 1912, was found on August 27, 1984 by a search team from the Prince Williams Community college. It is located not far from the tanker route from Valdez to other parts of the U.S.A. Natural landmarks abound in the region which connect the 1964 earthquake and associated changes with cultural events in Anchorage, Valdez and other coastal villages and towns.

### (6) Transportation

Air transportation is the principal means of travel in the State of Alaska. Because of this, air facilities are widely scattered throughout the state and for the most part well maintained. Airfields adequate to handle the logistics of OCS activities without taxing their operational capacity exist for this planning area.

Communities which may offer air support for offshore oil activities are Sitka, Yakutat, Cordova, and Seward. With the exception of Seward, all of these communities possess airfields which would accommodate jet aircraft and large cargo carries. The extensive use of the Seward airstrip by offshore operators would require the lengthening of the airstrip and the construction of a warehouse/terminal facility. Of these airports, Yakutat has the largest airfield with two landing strips in excess of 2,300 meters. None of these fields are operating at capacity. Sitka, the most used facility, handles approximately 26,000 operations per year, while the Yakutat airfield services only 10,000 operations per year.

In regard to marine transportation and navigation, traffic densities are in general light throughout Alaska waters except around major fishing ports during certain periods. Large ship traffic volume is significant in the vicinity of the oil terminal at Valdez. The oil terminal at Valdez currently processes approximately 750-800 tankers per year. Tanker movements to and from the terminal are controlled by a mandatory vessel separation system; however, other than tankers few large vessels enter the Valdez/Prince William Sound ship lanes.

Port facilities in the planning area are plentiful and a number could serve as support/supply base locations. Among the principal locations are Sitka, Yakutat, Cordova, and Seward. Yakutat and Seward have served as support bases for past OCS activities and contain the required facilities for such an effort. Cordova and Sitka have not in the past served as marine support facilities; but could serve with construction of additional infrastructure.

### (7) Subsistence-Use Patterns

The subsistence use pattern in this planning area consists primarily of 1. salt and fresh water fishing (all coastal towns); 2. sea mammal hunting but not whaling (all coastal towns); 3. upland game hunting (non-natives and inland villages). Recent comparative subsistence data are available to some extent for Tatitlek, Valdez, and Cordova. The amount of subsistence resource harvest and use for Tatitlek was shown to be as high as that found in the other primarly Aleut communities of English Bay and Port Graham in the lower Cook Inlet (fishing and small sea mammal hunting), while it was less among Valdez native households, including Cordova and Seward. Data for the use of subsistence resources in Cordova native households suggest a level comparative with other native households in the study area. Subsistence harvest patterns, however, were less centered on a family venture than on the activities of other groups or individuals. The overall level of effort in hunting and fishing activities does not appear to differ greatly for Cordova natives and non-natives. Cordova has a history of boom and bust economic cycles, and those households primarily committed to maintaining residence in Cordova use subsistence resource harvest as an important margin of security against the bust cycles. In Yakutat the subsistence harvest is similar for natives and non-natives although preferences vary. Natives utilize a wide variety of marine resources, whereas non-natives rely more heavily on moose. In Sitka and other Southeast communities subsistence hunting and fishing activities account for a substantial proportion (35-50%) of food productions (Cook Inlet/Gulf of Alaska Lease Offering DEIS, USDOI, 1984).

### (8) Sociocultural Systems

Communities in the Gulf of Alaska region reflect considerable variety in social makeup and cultural orientation, ranging from native fishing villages to the predominantly non-native communities of Whittier, Valdez, Seward, Cordova, Juneau, Sitka, Kechikan, Petersberg, Wrangell, Haines, Skagway, and Craig. Within the predomiantly non-native communities, there are generally fairly sizable Native populations. Yakutat is the northernmost Tlingit community, while Tatitlek and Cheniga Bay are Aluet communities. In the Southeast, Metlakatla is the largest Native community followed by Hoonah, Kake, Angoon, Klawock, Hydaburg, and Saxman. These Southeast communities encompass Haida, Tsimshian and Tlingit people. The particular Native tradition of each community is reflected in the community's sociocultural orientation: social organization, cultural values (particularly values placed on hunting, fishing, and gathering) and world view, and sociopolitical structure (Cook Inlet/Gulf of Alaska Lease Offering DEIS, USDOI, 1984).

## 2. Kodiak Planning Area

### a. Physical Environment

#### (1) Geology

The Kodiak shelf is underlain by two major tectonostratigraphic units. The acoustic basement on the shelf is composed of a highly deformed assemblage of flysch and mafic volcanic rocks, which range in age from Paleocene to Oligocene. The mantle on the acoustic basement is made up of gently deformed shelf sediments that are up to 25,000 feet in thickness and range in age from Miocene to Recent.

Folds and faults have a trend that is predominantly northeast and parallel to the axis of the Aleutian trench (Hoose et al., 1984).

#### (2) Physical Oceanography

In the Kodiak Planning Area the maximum significant wave height equals about 22 meters (73 ft), however, extreme wave height can reach about 40.5 meters (132 ft). Water depths range from approximately 50 meters to over 2000 meters beyond the shelf break. Sea ice does not form in this planning area, however, super-structure icing is common during the winter months.

#### (3) Water Quality

Water quality of the Kodiak planning area is considered pristine on the basis of limited trace metal and hydrocarbon analyses. Relevant trace metals occur in concentrations one or more orders of magnitude below applicable water quality criteria of the Environmental Protection Agency.

#### (4) Climate

The climate of the Kodiak area is classified as marine. Mild winters, cool summers, heavy precipitation, and strong winds are characteristic conditions. Mean air temperature ranges from approximately 1 degree C in February to 12 degrees C in August, averaging 5.8 Degrees C. Scalar mean winds average 17.3 knots, peaking at 22 knots in late fall. Mean wind speed averages 20 knots or more for five months of the year. Currents move north and east along the eastern side of Kodaiak Island and are confined to Shelikof Straits along its eastern side.

#### (5) Air Quality

Existing air quality in the Kodiak Area is considered pristine. The EPA has prepared emissions inventory and ambient air quality estimates for areas in Alaska with relatively low populations, based on general emission factor relationships with local economic base and demographic data. Using this method of air quality analysis, the EPA considers the Kodiak area to be in compliance with Federal ambient air quality standards. It is most likely that the area's air quality is far superior to the national and state standards. However, no air monitoring has been performed in the

### (b) Biological Resources

#### (1) Plankton

##### (a) Phytoplankton

Concentrations of chlorophyll have been found to be at a maximum in July near the mouth of Cook Inlet. About 100 km northeast of Afognak Island, the maximum value occurred in early May, possibly indicating a shelf bloom of phytoplankton. The chlorophyll concentration about 200 km east of Afognak Island, in the Gulf of Alaska did not change markedly during the sampling period of April to August. The highest primary productivity values (5-10 mc/sq.m./day) in this study were recorded in May.

Anderson et al. (1977) described phytoplankton trends from data collected from the neritic and oceanic zones of the Gulf of Alaska. Similar trends probably occur in the Kodiak area. These authors found a marked seasonal variation in levels of chlorophyll a in the surface layers of neritic areas, i.e., areas shoreward of 200 m depth. Spring averages were generally higher than summer averages. Similar trends were observed in chlorophyll a levels in the euphotic zone.

Microflagellates, which are members of the Chrysophytes and Cryptophytes, are numerically dominant in the oceanic areas of the Gulf of Alaska, while larger diatoms, such as *Thalassiosira* sp. and *Chaetoceros* sp., are dominant in the neritic areas. Anderson et al. (1977) did not distinguish between oceanic and neritic species because of the limited number of neritic stations sampled. (Dept. of Commerce 1980b)

##### (b) Zooplankton

Off Kodiak Island zooplankton biomass values (presumably settled volume) are about 200 cm3/1000 m3. North of Afognak Island 400 cm3/1000 m3 are reported. These data are for summer only and are based on very few samples. East of Afognak Island zooplankton volume varied from about 1 to 10 ml/m3 in the upper 25 m with maximum values in late May and early July. For the entire water column (1400 m deep) zooplankton volume estimates varied from 750 ml/sq.m. in early April to 1260 ml/sq.m. in early July. Since these samples were taken from deep oceanic waters these data may not be representative of the nearshore waters of the lease area.

Copepods were the most abundant holoplankters in the nearshore zone off Kodiak. Cnidarians, pteropods, amphipods, chaetognaths, larvaceans, and euphausiids were also important (present at greater than or equal to 70 percent of the stations). Zooplankton were more abundant on the shelf during the fall than in the spring (Dept. of Commerce 1980b).

#### (2) Fish Resources

The Kodiak Planning Area has large populations of several species of groundfish, all five species of Pacific salmon, three kinds of king crab, bairdi tanner crab, dungeness crab, five pandalid shrimp species, clams, and scallops. Pollock, halibut, cod, and sablefish are the major groundfish of commercial value. Salmon abundance in this area has generally been high during recent years. King crab and shrimp numbers are at low levels and fishing seasons are closed or very limited. The bairdi tanner crab is harvested from much of this area. The weathervane scallop and squid support small-scale fisheries, the latter species taken by foreign vessels.

### (3) Marine Mammals

There are at least 6,000 sea otters in the Kodiak planning area with major concentrations located around Afognak Island, the Barren Islands, Chirikof Island and the Trinity Islands. An estimated 80,000 Pacific harbor seals occur in the western half of the Gulf of Alaska region (Shumagin, Kodiak, and Cook Inlet planning areas). The world's largest breeding-pupping area is located on Tugidak Island south of Kodiak Island with other large pupping areas located at Seal Island (Afognak area) and Ugak Bay (of Kodiak Island). The largest breeding-pupping sites of the 136,000 Steller sealions in the Gulf of Alaska are located on Marmot Island (E. Afognak), and Barren Islands as well as the Semidi Islands and Chirikof Island south of Kodiak Island within the planning area. The majority of the 1.2 million northern fur seals that breed in the Bering Sea migrate spring and fall through this planning area with large concentrations occurring on the Albatross and Portlock Bank east of Kodiak Island.

The most abundant nonendangered cetaceans in the Kodiak planning area are killer and minke whales, harbor and Dall's porpoises, and Pacific white-sided dolphins. In the summer, dolphins, whale, and porpoises concentrate in waters south, east, and northeast of Kodiak Island which are areas of high fish abundance and serve as major foraging grounds for these species. Portlock and Albatross Banks are particularly heavily used areas. Minke whales, Dall's and harbor porpoises, and Pacific white-sided dolphins are most abundant in the Kodiak area during the summer. The porpoises are year-round residents while the minke whale and Pacific white-sided dolphin are rare in the Kodiak area during the winter. In the fall and winter, killer whales are numerous around Kodiak and in adjacent shelf waters, but not elsewhere in the Gulf of Alaska. Although the beluga population is concentrated in Cook Inlet, some occur in Marmot Bay (between Kodiak and Afognak Islands). The beaked and short-finned pilot whales are also found in pelagic areas southeast off Kodiak. A tentative sighting of northern right whale and dolphins occurred north of Afognak Island. These species are restricted to the North Pacific waters.

### (4) Coastal and Marine Birds

Approximately 1 million seabirds occupy 138 mostly small to medium (less than 10,000) colonies in the Kodiak Archipelago (Sows et al., 1978). The largest concentration (650,000) occurs in the Barren Islands. Principal species are storm-petrels, murres, kittiwakes and puffins. Nocturnal species (e.g., storm petrels) probably are more abundant than presently recorded.

Locations of major concentrations of colonies are given in the Gulf of Alaska/Cook Inlet (Sale 88) FEIS (1987); also, seasonal habitat use by marine and coastal birds in the Kodiak lease area would be similar to that discussed in this document. Important spring and summer feeding grounds are located in the vicinity of the Barren Islands and over the shelf off the east coast of Kodiak and Afognak Islands. Spring densities of shearwaters in this area may be exceptional (1543 birds/sq.km.; Gould et al., 1982), and numbers of waterfowl and alcids also are substantial. The Kodiak area also is important for overwintering waterfowl, seaducks, and seabirds (fulmar, kittiwakes, crested auklet and other alcids), particularly bays on northeastern and southern Kodiak Island, and Tugidak Island. Winter densities as great as 67 birds/sq.km. have been recorded (Arneson, 1980).

### (5) Endangered and Threatened Species

#### (a) Whales

The area of the Kodiak planning area where most whales are observed is the major feeding area of the Portlock and Albatross Banks. Gray whales concentrate along the northeast waters of Afongnak and Kodiak Island and between Kodiak and Trinity Island in spring. Between 15,000 to 18,000 gray whales migrate through the nearshore waters in spring and fall. Sperm and blue whales are most likely to be found in deep, pelagic waters from May to October. A spring and summer concentration of sperm whales occurs from 147° W westward seaward of the shelf break. There have been 3 sightings of blue whales in the Portlock and Albatross Banks since 1960. Fin and sei whales generally are found from the nearshore waters to the shelf break during spring continuing until fall (November). The right whales are the most rare and probably only number 200 individuals throughout the North Pacific. Historically right whales were abundant during the summer on the Portlock and Albatross Banks. In 1961 Japanese whalers, under permit, took 3 right whales on the Albatross Bank. Humpbacks feed during the spring and summer on the Portlock and Albatross Banks as one of their 3 preferred summer feeding areas in the Gulf of Alaska. Fall migrations to Hawaii and Mexico usually start in December from the Banks. They number between 850 to 1,400 in the entire North Pacific.

#### (b) Bird and Plants

Four threatened or endangered bird species may occur within or nearby the planning area. A population of geese similar to the Aleutian Canada goose subspecies nests on the Semidi Islands just west of the planning area and may migrate over the planning area during the spring and fall (see Section III.D.1.b.(5)). The arctic or American peregrine falcon may occasionally occur adjacent to the planning area during migration or the winter period (see Section III.D.1.b.(5)). The short-tailed albatross is highly mobile and may occasionally occur in the planning area.

There are no plant species adjacent to the planning area listed as threatened or endangered. Only one candidate plant species is adjacent to the Kodiak planning area, (Poa eyerdamii).

### c. Socioeconomic Environment

#### (1) Employment and Demographic Conditions

The total full time equivalent (FTE) employment in Kodak for 1980 was 4,492 (ISER, 1983). FTE is a measure of the amount of work accomplished during the year within a given industry. This measure provides a figure for analysis that produces a level estimate of the community's employment from year to year. Since some industries area seasonal, the actual number of people working during any given period may be larger or smaller than the FTE total. However, FTE provides a consistent, comparable number that is representative of the aggregate work performed with seasonal employment.

The largest sector of employment is fishing and fish processing, which together represent half of the FTE employment. The second largest sector is military.

The 1980 resident population of Kodiak constituted a 20-percent increase over the 1970 population--from 3,798 to 4,756 persons. The 1970 census count also represented an increase over the 1960 count of 2,628. As a major commercial fishing port in Alaska, Kodiak experiences an increase in nonresident population seasonally for a variety of fisheries. The Native/non-Native composition of the population in Kodiak has remained fairly proportionate over the last 20 years, with Alaska Natives comprising 13-15 percent of the total population.

#### (2) Coastal Land Uses

The principal land owners in the Kodiak Island area are the federal government, Native Corporations, State of Alaska, and Kodiak Island Borough. The major federal land holding includes the Kodiak National Wildlife refuge on Kodiak and Afognak Islands. Native Corporation holdings are primarily on Afognak and Sitkalidak Island and adjacent to the communities of Port Lions, Old Harbor, Larson Bay, Karluk, and Akhiok. State of Alaska land occur primarily on the Trinity Islands and the northeast section of Kodiak Island.

The vast majority of the Kodiak Island area is undeveloped, and development is limited to the seven communities, with the exception of timber and agriculture uses. Agricultural land use consists entirely of livestock grazing. Grazing is concentrated along the Kodiak road system and on Sitkalidak Island. Timber harvesting is limited to Afognak Island and is concentrated in the central portion of the island.

#### (3) Commerical Fisheries

Kodiak area commerical fisheries at this time are dominated by the Island and Alaska Peninsula salmon fishery. Pinks comprise most of the harvest; with sockeye and chum salmon also taken in quantity. Lesser numbers of coho and chinook are caught. Set nets, drift gillnets, and purse seines are employed by the salmon fishery. There are joint venture trawl fisheries for the large spawning population of walleye pollock in Shelikof Strait in the spring, and the domestic fishery for groundfish also longlines for halibut, sablefish, and cod. There are fall and winter fisheries for tanner and dungeness crab; and depending on recovery of the stocks, for king crab. There is a spring fishery for herring with the product being sac roe. Formerly the nation's first-ranked port in value of fisheries landings, Kodiak has been supplanted by Boston due to the decline in the crab fishery. Commercial fisheries from the waters surrounding Kodiak brought almost $100 million to the fishermen in 1982. Over 100 million pounds of salmon, crab, shrimp, halibut, and groundfish were caught. Overall catch figures did not vary significantly from previous years; however, salmon, king crab, and shrimp were down significantly from 1981 and groundfish catch was up. Thus, the total ex-vessel value of the fisheries (value to the fishermen) was down from the 1981 high of $125 million due to the decline of these higher-valued species.

Kodiak's economy also revolves around fish processing. During the 1982-1983 fishing season, eleven Kodiak firms processed both salmon and shellfish. Eight more companies processed salmon and four more processed shellfish.

### (4) Recreation and Tourism

The Kodiak Island Group and the adjacent Alaska Peninsula near Kodiak Island is recognized as one of the most scenic and recreationally attractive areas in Akaska. The area offers opportunities for a variety of recreational activities including sport fishing, hunting, collecting, and sightseeing. Much of the area is primitive and is essentially wilderness. Brown bear, moose and caribou are the major big game species hunted on the northern Alaska Peninsula by residents and tourists of Kodiak Island. Power boating and sailboating are possible on several of the larger lakes and protected bays on Kodiak, Afognak, and Raspberry Islands.

### (5) Archaeological Resources

Research in the Kodiak Island area has revealed an extensive prehistoric occupation, extending nearly 6,000 years into the past. This cultural sequence represents a succession of maritime hunting and food gathering cultures. The sequence can be outlined in phases from oldest (6500 B.C.) to youngest (1300 A.D.) as Ocean Bay I, Ocean Bay II, Kachemak, and Koniag. The historic period of Kodiak began in 1974 when the Russian fur post was founded at Three Saints Bay by Gregor Shelekov. This was the first permanent Russian settlement in the New World, and it marked the beginning of a period in which there were great changes in relationships between the Russians and the native Koniag Eskimos. Many historic sites and artifacts remain from this period. On the Shelikof Strait side of Kodiak Island offshore, archaeological resources are highly probable although still undiscovered. In the offshore area just out from the village of Ayakulik there are land forms which hold promise of prehistoric resources. About 20 shipwrecks occurred offshore around Kodiak Iskand between 1878 and 1920. These are archaeological resources which if found would add considerable information about marine culture.

### (6) Transportation

Air support for oil and gas operations off Kodiak Iskand will probably emanate from Kodiak airfield. The airfield is serviced by hangar, terminal and maintenance facilities. It contains 3 runways, the longest of which is nearly 2,300 meters. Two airline companies currently offer scheduled jet service to Kodiak City. The field handles between 40 and 45,000 operations per year and is currently operating under capacity. In regard to marine support facilities principal support is expected to issue from the Kodiak City/Chiniak Bay facilities. The Chiniak Bay region is home to one of the active fishing ports in the United States. Besides numerous canneries, the bay contains two commercial docks (one owned by the city) and an oil pier. These facilities are currently operating above capacity.

### (7) Subsistence-Use Patterns

Residents of the 3 villages on Kodiak Island plus the city of Kodiak have a maritime cultural tradition and are dependent on the sea. The pattern of subsistence use in the villages on Kodiak Island consists of 1. fishing for salmon, halibut, and other fish in summer, 2. hunting and gathering sea mammals, shellfish, and intertidal resources in winter and spring, 3. hunting for deer, ducks, rabbits, and ptarmigan to provide the major protein sources in winter, and 4. summer fishing and berry picking for both summer and winter family reserves (Cook Inlet/Gulf of Alaska Lease Offering DEIS, USDOI, 1984). Time spent in subsistence activities is more in the 3 villages than in Kodiak.

### (8) Sociocultural Systems

The City of Kodiak is the largest and most culturally diverse community on Kodiak Island. The single most unifying aspect among sociocultural groups in Kodiak is the fishing industry, the economic mainstay of the community and the factor that permeates the entire social fabric of the community. Elsewhere on Kodiak Island, the villages that are oriented to the Shelikof Strait are much smaller and culturally homogeneous. These settlements (Karluk, Larsen Bay, Ouzinkie, and Port Lions) are primarily Aleut villages. Each village represents small systems of extended families which are subsistence-and family-oriented and predominantly Russian Orthodox, in keeping with a long history of Aleut-Russian contact (Cook Inlet/Gulf of Alaska Lease Offering DEIS, USDOI, 1984).

## 3. Cook Inlet Planning Area

### a. Physical Environment

#### (1) Geology

Mesozoic and Cenozoic sedimentary rocks are a part of a belt that underlies the upper Cook Inlet, the Alaska Peninsula, and the Shelikof Strait. Marine Mesozoic rocks found locally along this belt may be more than 11,000 meters thick. The continental Cenozoic rocks are as much as 7,600 meters thick. Four major geologic features can be found on the flanks of Cook Inlet. They are the Alaska-Aleutian Range batholith, the Brun Bay fault, the Border Ranges fault, and the terrace of undifferentiated Mesozoic and Cenozoic rocks.

The Mesozoic rocks that fill the basin beneath lower Cook Inlet and the Shelikof Strait are deformed into a broad geosyncline. Local structures superimposed on this feature include a lineation of small anticlines near the southeast flank of lower Cook Inlet, a few small anticlines beneath Shelikof Strait, and the Augustine-Seldovia Arch.

#### (2) Physical Oceanography

In Cook Inlet/Shelikof Strait the maximum significant wave height equals about 21.5 meters (70 ft), however, extreme wave height can reach about 38 meters (125 ft.). Water depths range from approximately 20 meters to over 300 meters in lower Shelikof Strait.

During a severe winter, sea ice may be present in Cook Inlet from Anchor Point on the eastern side as far as Cape Douglas on the western side. The ice cover lasts less than 30 percent of the year and reaches almost 100 percent coverage in the upper Cook Inlet during the coldest times. Currents are tide influenced and are primarily north and south as the tide flows.

#### (3) Water Quality

Water quality of the Cook Inlet/Shelikof Strait is considered pristine on the basis of limited trace metal and hydrocarbon analyses. Relevant trace metals occur in concentrations one or more orders of magnitude below applicable water quality criteria of the Environmental Protection Agency.

#### (4) Climate

The climate of the Cook Inlet/Shelikof area is representative of a transition area from a continental climate to a marine climate. Mean air temperature ranges from -3 degrees C in January to 13 degrees C in August, averaging 4.4 degrees C. Scalar mean winds average 14 knots, peaking at 18 knots in late fall. Mean wind speed averages 15 knots or more for five months of the year.

#### (5) Air Quality

Existing air quality in the Cook Inlet/Shelikof Strait is considered pristine. The EPA has prepared emissions inventory and ambient air quality estimates for areas in Alaska with relatively low populations, based on general emission factor relationships with local economic base and demographic data. Cook Inlet/Shelikof Strait is considered to be in compliance with Federal ambient air quality standards. It is most likely that the area's air quality is far superior to the national and state standards.

### b. Biological Resources

### (1) Plankton

### (a) Phytoplankton

Microflagellates and diatoms dominate phytoplankton populations in Cook Inlet green algae and dinoflagellates were present for only short periods. Microflagellates were usually found in the southernmost parts of the Inlet, and a small centric diatom, *Melosira sulcata*, was usually found in the upper parts of Lower Cook Inlet. *Chaetoceros* spp. and *Thalassiosira* spp. were the dominant phytoplankton in the central portions of the Inlet and in Kachemak and Kamishak Bays.

The phytoplankton distributions are highly correlated with the hydrographic and chemical characteristics of the Inlet.

The highest primary production was measured in Kachemak Bay, with a peak of 4.9 g C/sq.m./day in May. This value was two orders of magnitude greater than at other stations in Lower Cook Inlet. (Dept. of Commerce 1979)

### (b) Zooplankton

A peak in zooplankton densities (in the main part of Lower Cook Inlet) was observed in early July, whereas in Kachemak Bay a peak was observed in early May. These patterns closely parallel those observed for the phytoplankton during the same period. The pattern of seasonal abundance of zooplankton observed in Cook Inlet is similar to that observed in the more open waters in the Gulf of Alaska. The different pattern observed in Kachemak Bay is probably indicative of water conditions found there.

The abundance of zooplankton increased from April through August. The copepods *Pseudocalanum* sp., *Acartia longiremis*, and *Oithona similis*, and barnacle nauplii were the most abundant taxa. The barnacle nauplii were abundant in the April, July, and August samples but were absent from samples taken in May. Barnacle cyprids (the second larval stage) were taken in May, July, and August.

Deep water locations usually had a more diverse fauna (35 species) than shallow-water or bay locations (18 species) (Dept. of Commerce 1979).

### (2) Fish Resources

All five species of Pacific salmon are found in the Cook Inlet. These are chinook (king), sockeye (red), coho (silver), pink (humpback), and chum (dog).

The Pacific herring is an abundant and widespread forage fish of the Pacific Ocean and Bering Sea. In dense schools in these waters, herring provide food for other marine fishes, birds, and mammals. In Cook Inlet herring occur in Kachemak and Kamishak Bays. Halibut and yellow fin sole are the only ground fish that occur in numbers in Cook Inlet.

King, Dungeness and Tonnes crab are also present in Cook Inlet. Shrimp, predominately pink shrimp, razor clams, butter clams and cockle are present in sufficient numbers to be harvested. Octupus also inhabit lower Cook Inlet waters.

In all about 365 species of vertebrate and invertebrate "fish" species are present in this planning area.

### (3) Marine Mammals

Several thousand sea otters occur in the planning area with major concentrations present in Kamishak Bay-Cape Douglas area, Kachemak Bay-Kenei Peninsula coast, Barren Islands, and Afognak Island coastal habitats. Several thousand Pacific harbor seals are also present with a major pupping-breeding area located on Augustine Island (W. Cook Inlet) and numerous haulout-breeding concentrations occurring throughout the planning area coast. A major breeding-pupping concentration of Steller sealions is located on the Barren Islands with major winter haulout concentrations occurring in Puale Bay (W. Shelikof Strait) and Shuyak Island (northeast Shelikof Strait) within the planning area. Some of the 1.2 million northern fur seals move through this planning area during spring and fall migrations.

Nonendangered cetaceans inhabiting the Cook Inlet planning area include beluga, killer, and minke whales, and harbor and Dall's porpoises. They are generally more abundant in the area during the spring and summer.

The Cook Inlet/Gulf of Alaska beluga population of approximately 500 individuals is believed to be a genetically isolated stock. Most of this population inhabits upper Cook Inlet north of 60°N where they are present year-round, but they have also been observed within the planning area in Shelikof Strait and around the Barren Islands. Belugas are generally confined to shallow, central waters. The seasonal distribution of belugas in Cook Inlet is strongly influenced by fish availability, particularly smelt and salmon smolt. There has been a stranding of a Bering Sea beaked whale in Homer.

### (4) Coastal and Marine Birds

Approximately 400,000 seabirds occupy mostly small to medium (less than 10,000) nesting colonies around the perimeter of the Cook Inlet/Shelikof

Strait lease area during the breeding season (Sowls et al., 1978). An additional 650,000 occupy colonies in the Barren Islands just outside the eastern boundary of the lease area. Locations of major concentrations of colonies, as well as discussion of marine and coastal bird density, are given in the Gulf of Alaska/Cook Inlet (Sale 88) FEIS (1984).

Nocturnal species (e.g., storm-petrels) probably are more abundant than presently recorded. Highest average coastal bird density (192 birds/sq.km.) occurs in spring, when large numbers of migrant waterfowl and shorebirds swell the substantial numbers of overwintering waterfowl and seabirds (Arneson, 1980). Highest recorded density is 1,111 birds/sq.km. in the lower inlet area; the most abundant species are fulmar, shearwaters and tufted puffin (Gould et al., 1982). Habitat use is similar in spring, summer and fall; those associated with bays and lagoons, as well as offshore foraging areas associated with major colony areas, are used most heavily. The most important overwintering areas for waterfowl and seabirds include Kachemak Bay and the western Kodiak Island/Shelikof Strait area (Forsell and Gould, 1981).

### (5) Endangered and Threatened Species

#### (a) Whales

No endangered whales occur in Cook Inlet but gray, fin and humpback whales occur in Shelikof Strait. The secondary migratory route of the gray whales passes between the Alaska Peninsula and Kodiak Island in spring. Humpback and fin whale usage of habitats in this area mostly occurs between Kodiak Island and lower Cook Inlet during the summer months.

The area of the Kodiak planning area where most whales are observed is the major feeding area of the Portlock and Albatross Banks. Gray whales concentrate along the northeast waters of Afognak and Kodiak Island and between Kodiak and Trinity Island in spring. Between 15,000 to 18,000 gray whales migrate through the nearshore waters in spring and fall. Sperm and blue whales are most likely to be found in deep, pelagic waters from May to October. A spring and summer concentration of sperm whales occurs from 146° W westward seaward of the shelf break. There have been 3 sightings of blue whales in the Portlock and Albatross Banks since 1960. Fin and sei whales generally are found from the nearshore waters to the shelf break during spring continuing until fall (November). The right whales are the most rare and probably only number 200 individuals throughout the North Pacific. Historically right whales were abundant during the summer on the Portlock and Albatross Banks. In 1961 Japanese whalers, under permit, took 3 right whales on the Albatross Bank. Humpbacks feed during the spring and summer on the Portlock and Albatross Banks as one of their 3 preferred summer feeding areas in the Gulf of Alaska. Fall migrations to Hawaii and Mexico usually start in December from the Banks. They number between 850 to 1,400 in the entire North Pacific.

#### (b) Birds and Plants

The arctic and American peregrine falcon may occasionally occur adjacent to the planning area during migration or the winter period (see Section III.D.1.b.(5)).

There are no plant species adjacent to the planning area listed as threatened or endangered. The candidate species, alkali grass is found adjacent to the planning area.

### c. Socioeconomic Environment

#### 1. Employment and Demographics

The total full-time equivalent (FTE) employment for the Kenai market area for 1980 was 4,270 (ISER, 1983).

Service, with 921 FTE employment, was the largest segment of the employment spectrum in the Kenai marekt area in 1980. It was followed closely by the trade segment, which had 792 FTE employment. Together, service and trade accounted for 40 percent of the Kenai market area FTE employment for 1980. The Kenai/Soldotna area lead in resident population in 1980 of 6,644 (40% increase from 1970).

The total full-time equivalent (FTE) employment in the Homer area is 2,069 (ISER, 1983). FTE is a measure of the

The largest segments of employment in Homer are fishing and fish processing. They provide forty-three and one-half percent of the total FTE employment.

During the peak season, employment expands by one-third; and the number of nonresidents employed in the Homer area more than doubles. The nonresident FTE employment of 323 grows to 711 during the peak season, when nonresidents constitute over one-fourth of the total employment.

Homer's 1980 resident population of 2,209 was more than double the population of 1970, but the 1970 population of 1,083 represented a decline from the 1960 count of 1,247. In recent years, the total population of Homer has increased considerably during the summer months wth the addition of fisheries and tourism operatives and an influx of tourist visitors, especially on weekends as it does on all the Kenai Peninsula.

Alaska Native component of the Peninsula's population has comprised only about 4 percent of the population in the last two census counts.

#### (2) Coastal Land Uses

The majority of land adjacent to the Cook Inlet Planning Area is under federal, State of Alaska, Borough government or native corporation ownership. Major federal land holdings include Lake Clark and Katmai National Parks and Preserves administered by the National Park Service and the Kodiak, Becharof, and Tuxedni National Wildlife Refuge and Kenai National Moose Range administered by the U.S. Fish and Wildlife Service.

State lands area primarily located in the Beluga River/Tyonek area, Kamishak Bay Area, Kenai Peninsula lowlands and the Kachemak Bay area. With the exception of the Beluga River/Tyanek area on the west side of Cook Inlet, which has coal deposits and potential oil and gas reserves, most other lands have been obtained to protect important fisheries, waterfowl, and big game habitat. The major state sanctuaries, refuges, and critical habitats in the Kenai Peninsula and on the west coast of Cook Inlet include coastal lands. Some of the critical habitats include tidelands or submerge lands. The Department of Natural Resources administers these areas; however, management guidelines are provided by the Department of Fish and Game.

The Kenai Peninsula Borough encompasses lands on the Kenai Peninsula and on the western side of Cook Inlet. In general, the borough is sparsely populated with the North Kenai, Kenai, and Soldontna corridor having the greatest intensity of development. Homer is the other major community bordering Cook Inlet.

The Kodiak Island Borough primarily encompasses Kodiak, Afognak and a number of smaller islands. Most of the Borough is made up of the Kodiak NWR where developments are isolated or nonexistent. The majority of the borough is undeveloped with the exception of the seven borough cities and timber and agricultural uses. The City of Kodiak is the major commerical center in the borough with use concentrated along the waterfront and major roads. The primary industry in the borough is fish processing which is concentrated in the City of Kodiak.

### (3) Commericial Fisheries

Commercial fishing is an important segment of the economy for the Cook Inlet communities of Kenai and Soldotna but is not the dominant source of income. The major fishery is seasonally for salmon with sockeye predominating. Salmon are harvested primarily by drift and set gillnets. The Kenai/Soldotna fishermen operate throughout Cook Inlet and their catch is processed in a number of locations. Seward, Anchorage, Kenai, Ninilchik, and Homer have salmon canneries or other processing facilities that handle fish taken throughout Cook Inlet.

Kenai has a small-boat harbor at the mouth of the Kenai River. During the season, fishing boats also moor upriver; and storage is widely used during the off season. Most of the salmon fleet, however, harbors at Kasilof and Ninilchik during the season.

Homer area commercial fishing fleets now target on all species of salmon; king, tanner, and dungeness crab; shrimp; and halibut. There has been a herring sac roe fishery; however, present stocks are too low for commercial exploitation. Groundfish are not taken commercially by Homer-based vessels at this time (personal communication, July 1983, Hazel Vanderbrink, Alaska Dept. of Fish and Game (ADF&G), Homer). During the summer of 1983, two relatively large shore-based fish processors operated in Homer, another large firm purchased salmon here for processing at Port Graham, and several small operators process a few fish. Freezing is the major processing method (personal communication, August 1983, Vanderbrink, Homer).

Salmon and halibut catches have increased during the period 1979-80, the crab harvest has remained constant, and the shrimp quotas and catch have risen gradually (Schroeder, ADF&G, 1980).

Vessels fishing from Homer are varied, ranging from open skiffs to larger trawlers. Because of the transient and seasonal nature of the Alaskan fisheries, there is a concurrent variance in vessel numbers berthed at Homer. The Homer small-boat harbor has 398 berths, but many more vessels dock on a short-term, space-available basis.

### (4) Recreation and Tourism

Recreation and tourism resources of the Kenai Peninsula are outstanding. Visually, each area is varied and interesting. Rugged mountains, forest, grassy area, lakes, rivers, and coastline characterize each area. The Alaska Peninsula is famous for its volcanoes. Each area bordering Cook Inlet is well known for its wildlife, be it moose, brown bear, black bear, or birds. The shores and area surrounding the Cook Inlet lease area contains vast acreage of what most would term "wilderness". The Kenai Peninsula contains a road system that seems extensive when compared with roadless areas on the Alaska-range (west) side of Cook inlet. Resources for sightseeing, fishing, hunting, boating, camping, photography, berry picking, cross-country skiing, wildlife viewing, hiking, and snowmobiling exist in abundance in the region. The Kenai River is used heavily for recreational purposes. Fishing trips to Lake Clark and Lake Iliamna attract international as well as national and state visitors.

### (5) Archaeological Resources

The shoreline surrounding the proposed planning area has numerous archaeological resources of prehistoric and historic value. The predominant types of prehistoric resources found on the shores near the proposed area are housepits containing the household and subsistence artifacts (stone lamps, sinkers, arrowheads, etc.) of early people. Historic artifacts found onshore near the proposed area consist of early Russian houses, churches, roadway inns, fish camps, mining camps and other reminders of historic times. Submerged artifacts, if found, would be similar to those on the shore but are likely to be scattered by tidal currents and geological changes. A number of shipwrecks in the area indicate a potential for salvage if these wrecks should be discovered.

### (6) Transportation

The Cook Inlet planning unit extends into the Shelikof Straits. The northern portion of the planning unit is served by infrastructure established on the Kenai Peninsula as a result of oil discoveries on submerged state lands in the upper Cook Inlet. The southern portion of the subject area is comprised by the Shelikof Strait and is for the most part pristine. Air support for the upper portion of planning unit would issue primarily from Homer, for the southern areas from the Kodiak city airfield. The airfield at Homer is 2,200 meters in length, handles approximately 34,000 operations per year and can accommodate jet aircraft. Marine support, for the entire planning unit, is expected to be provided from the rig tenders dock in Kenai. The dock is adjacent to a dedicated oil field supply yard.

### (7) Subsistence-Use Patterns

Subsistence-use patterns vary considerable in the Cook Inlet region due to the diversity of the population. Smaller, more traditional villages will harvest salt and fresh water fish and small sea mammals in summer and fall, moose in the fall and invertebrates and some sea mammals all year. People in the more industrially based towns will fish in summer and hunt in fall refelcting on larger proportions of households (about 42%) not using local wildlife resources.

English Bay and Port Graham residents (perhaps 100% of population) harvested and used a wide range of subsistence resources in 1980 in comparison with more industrially-based communities such as Valdez and Seward. The data suggest a considerable network of resource sharing and distribution within the communities. These two villages are closely related by family ties, common hunting and fishing practices, and local custom. Ninilchik households harvest a restricted range of resources and have heterogeneous resource patterns across households, limited time invested in fishing and hunting, and low distribution and sharing of fish and game products. Ninilchik households harvested an average total of 184 pounds of salmon, halibut, clams, and moose in 1982; more than that harvested in the Kenai-Soldontna area. Subsistence resources used in Seldovia are similar in many respect with those found in Homer and Ninilchik. Resources used in Selodvia are characterized by variable resource patterns across households and few target species (primarily salmon, halibut, clams, and moose) harvested. Resource harvest levels and distribution-exchange networks may be somewhat larger than in other Kenai Peninsula communities. Subsistence harvests are integrated with commerical fishing or wage employment (Gulf of Alaska/Cook Inlet Lease Offering, DEIS, USDOI 1984).

### (8) Sociocultural Systems

Cook Inlet today contains a mixture of Alaska Native residents as a result of intensive local urbanization. The Koniag and Chugach regions are described as the home of the Sukpiat Eskimo group - speaking Akutiiq, although they identify themselves as Aleut. The relative isolation of Port Graham and English Bay has allowed these communities to maintain their Aleut identity and traditions with limited external interference. Seldovia and Ninilchik have deep historical roots in the area and have undergone considerable social and cultural change. Seldovia has a relatively stable population and Alaska Native population of Eskimo, Athabascan, and Aleut heritage, Ninilchik, which was previously an isolated Russian Orthodox fishing village, now has new residents with non-local employment such as on the North Slope or Cook Inlet offshore platforms. New residents have brought a wide range of values, beliefs, skills, and cultural traditions, but this heterogeneous community still retains a sizable core of lifelong Ninilchik families engaged in commerical fishing (Cook Inlet/Gulf of Alaska

Lease Offering DEIS, USDOI, 1984).

## 4. Shumagin Planning Area

### a. Physical Environment

#### (1) Geology

This area consists mostly of the Aleutian Abyssal Plan which was formed by Eocene-Oligocene turbidite deposits. These turbidites were deposited from many buried channels and surficial channels, but mainly from four great channels located in tne north and northeast.

Turbidite thickness ranges from 400-800 meters in the north to about 200 meters in the south.

Faulting and flexure of the oceanic crest seaward of the Aleutian Tranch have strongly affected the depositional channels (Hamilton, 1973).

#### (2) Physical Oceanography

In the Shumagin Planning Area the maximum significant wave height equals about 22 meters (73 ft), however, extreme wave height can reach about 39 meters (129 ft.). Water depths range from approximately 100 meters to over 3000 meters off the shelf break. Sea ice does not form in this planning area.

#### (3) Water Quality

Water quality of the Shumagin area is considered pristine on the basis of limited trace metal and hydrocarbon analyses. Relevant trace metals occur in concentrations one or more orders of magnitude below applicable water quality criteria of the Environmental Protection Agency.

#### (4) Climate

The climate in the Shumagin area is classified as marine. Mild winters, cool summers, heavy precipitation, and strong winds are characteristic conditions. Mean air temperature ranges from approximately 1 degree C in winter to 11 degrees C in August, averaging 5.1 degrees C. Scalar mean winds average 17.6 knots, peaking at 22 knots in October. Mean wind speed averages 20 knots or more for five months of the year.

#### (5) Air Quality

Existing air quality in the Shumagin area is considered pristine. The EPA has prepared emissions inventory and ambient air quality estimates for areas in Alaska with relatively low populations, based on general emission factor relationships with local economic base and demographic data. Using this method of air quality analysis, the EPA considers the Shumagin area to be in compliance with Federal ambient air quality standards. It is most likely that the area's air quality is far superior to the national and state standards. However, no air monitoring has been performed in the Shumagin Planning Area.

### b. Biological Resources

#### (1) Plankton

Information on both phyto and zooplankton is lacking in the Shumagin area. It is assumed however that productivity and species composition closely resemble that in the Gulf of Alaska and Kodiak areas.

#### (2) Fish Resources

Groundfish, shellfish, salmonids, and mollusks are the major groupings for this planning area with the groundfish in greatest quantity and of major economic importance. Pacific cod, sablefish, halibut, and several other flounder species are the dominant groundfish species; red king crab and pandalid shrimp were formerly the major economic shellfish until recent population declines. All species of Pacific salmon are harvested from these waters and there are rearing populations of this group as well. Sockeye, pink, and chum salmon predominate in the commercial catch from the inshore fisheries.

#### (3) Marine Mammals

Several thousand sea otters are present along the coast of the Shumagin planning area with small populations located between Unimak Island east to Amber Bay on the south side of the Alaska Peninsula. High densities of sea otters are present around the Sanak Islands and small islands south of Cold Bay along the Alaska Peninsula. Several thousand Pacific harbor seals and Steller sealions occur in the planning area with haulout and breeding areas located at several sites along the coast. Major Steller sealion breeding-pupping sites are located on the Sanak Islands and small islands south of Cold Bay along the Alaska Peninsula. Most of the 1.2 million northern furseals that breed in the Bering Sea region migrate spring and fall through this planning area and Unimak Pass.

The Shumagin planning area includes Unimak Pass, the major migratory route for cetaceans between the Gulf of Alaska and the Bering Sea. Killer and minke whales and Dall's porpoises inhabit the area year-round. Killer whales appear to moderately gregarious animals with strong social bonds and a stable group structure. As a top predator, killer whales hunt marine mammals, fish and sometimes sea birds. The harbor porpoise inhabits nearshore areas along the Alaska Peninsula and eastern Aleutians most frequently in the summer and fall. The current population estimates are of approximately 1,000 individuals in the Gulf of Alaska (including Kodiak and Shumagin). Less commonly observed species include the Pacific white-sided dolphin, short fin pilot whale, northern right whale dolphin, goosebeak whale, and giant bottlenose whale.

#### (4) Coastal and Marine Birds

At least 4.6 million seabirds occupy 142 colony areas in the Shumagin lease area islands (0.9 million), Sandman Reefs/Deer Island area (0.9 million), Mitrofania Island area (0.3 million) and eastern Unimak Pass (0.3 million). Within this lease area, frequency of large colonies is: 50,000 individuals-6; 100,000-10; 200,000-3; 400,000-2; 500,000-1. Locations of colonies are shown in the St. George Basin (Sale 89) DEIS (1984). Nocturnal species (e.g., storm-petrels) probably are more abundant than presently recorded. Offshore seabird populations are dominated by shearwaters in spring, summer and fall (Gould et al., 1982). For example, in spring highest recorded total bird density was 2,858 birds/sq.km.; shearwater density contributed 2,828 birds/sq.km. Likewise, highest recorded values for all species and shearwaters in summer and fall are 1164 (1159) and 1581 (1551). Such high densities of shearwaters are not found uniformly throughout the area of course, thus substantial numbers of fulmars, storm-petrels, kittiwakes and several alcid species are recorded in one or more of these seasons. Inshore populations samples in fall are dominated by geese, ducks and gulls, with total bird densities as high as 363 birds/sq.km. Winter populations are dominated by waterfowl and alcids. The Cold Bay area in particular, and probably other south peninsula bays as well, provides important overwintering habitat for waterfowl. Large numbers of seabirds overwinter in the eastern Aleutians.

### (5) Endangered and Threatened Species

#### (a) Whales

All seven previously mentioned endangered species are likely to occur in the Shumagin planning area. Gray whales funnel through Unimak Pass on their migrations to summer feeding areas further north. Most whales will pass through this planning area and then through Unimak Pass to feeding areas in the Bering and Chukchi Sea. Whales are most likely to be present from late August through June and September through December. The sei whale North Pacific population estimate is around 8,000 to 9,000 individuals.

#### (b) Birds and Plants

Two endangered species, the Aleutian Canada Goose and short-tailed albatross may occur within or near the planning area. A population of geese which resemble the Aleutian Canada Goose nest on Kilktagik Island in the Semidi Islands within the planning area and are currently the subject of a Toxonomic study. (See Section III.D.1.b.5.). The short-tailed albatross is highly mobile and may occasionally occur in the planning area.

There are no plant species adjacent to the planning area listed as threatened, endangered, or currently considered candidates for federal listing.

## c. Sociocultural Environment

### (1) Employment and Demographic Conditions

The Shumagin area with 3 villages, Sand Point, King Cove and Cold Bay have about 4,000 residents with an annual growth rate of about 2%. Sand Point and King Cove are fishing and fish processing villages. Cold Bay hads predominantly Federal and State paid residents with some airline personnel.

### (2) Coastal Land Uses

Coastal lands adjacent to the Shumagin Planning Area are primarily in federal (USFWS and NPS) or native corporation ownership. USFWS lands adjacent to the planning area include the Alaska Peninsula and Becharof NWRS. These lands are primarily managed for fish and wildlife habitat or harvest and recreation while secondary uses include oil and gas exploration and development where compatible in the refuge plan. Native corporations and the State have in holding in the Alaska Peninsula NWR. The National Park Service manages Anakchak National Monument and Preserve which is adjacent to the planning area.

Residential and commercial developments are primarily located in 9 communities along the Pacific Ocean.

### (3) Commercial Fisheries

The area commercial fisheries are comprised of the domestic salmon, shellfish, and groundfish, (principally halibut), and the foreign trawl and longline fisheries for groundfish (largely walleye pollock). The salmon fishery operates from May through the end of August and employs set and drift gillnets, and purse seines. It is an inshore fishery off the south Alaska Peninsula, Shumagin Islands, and eastern Aleutians. Pot fisheries for king and tanner crab occur during fall and winter, but king crab stocks are at low levels in this planning area and this fishery is very limited in harvest quota and fishing season. Pacific cod and halibut, and sablefish are taken by the domestic longline fishery. There is no fishery for shrimp or for any of the mollusks; shrimp stocks are low and the mollusks are undeveloped. Foreign vessels, largely Japanese, trawl for pollock, turbot, and a number of other flounders. There is also a foreign longline fishery for sablefish. Currently, herring are not fished commercially in the Shumagin planning area.

### (4) Recreation and Tourism

Recreation and tourism resources in the proposed Shumagin lease area are extensive. The region around Balboa Bay is particularly rich in resources since this is a probable route of a portage used by early man to and from the Bristol Bay area. The shoreline provide scenic resources and natural resources for the hunter and fisherman.

### (5) Archaeological Resources

Archaeological resources of the Shumagin area are likely to be numerous, however complete surveys have not been done. Over 75 known archaeological sites are listed. They include subsistence gathering sites, churches and shipwrecks. A number of shipwrecks occurred in the area between 1893 and 1920.

### (6) Transportation

The regions adjacent to the Shumagin planning unit, the southern shore of the Alaska Peninsula and the southern tip of Kodiak Island, are largely devoid of infrastructure suitable to support offshore oil activities. An exception to this general statement is the airport at Cold Bay. Located 1,000 kilometers southwest of Anchorage, the Cold Bay airport consists of two asphalt runways; the longest of which is some 3,200 meters. The airport is owned and operated by the State of Alaska. Terminal facilities include a flight service station, quonset huts for storage and minor maintenance, a post office and a general store. Few other locations could qualify as air support locations, one of which is the village of Sand Point and in that case only after substantial lengthening and paving the airstrip. Developed marine facilities suitable for oil support bases are nonexistant. Such facilities would be constructed at a location suitably proximate to offshore activities. A number of suitable deep water employments, which would provide shelter for support vessels, exist within the subject region.

### (7) Subsistence-Use Patterns

There has not been an Environmental Impact Statement (EIS) written for a lease sale in the Shumagin Planning area, however for subsistence-use patterns in the Bristol Bay region, Cold Bay, Unalaska, Sand Point, and the lower Alaska Peninsula subregion, see Section III.D.6.c.(7). As in other communities in the Bristol Bay region, fishing as a means of livelihood is an important part of the Aleut culture in the Chignik subregion. The primary resources utilized in the Chigniks are caribou, salmon, and moose (Impact Assessment, Inc., 1982).

### (8) Sociocultural Systems

For sociocultural systems in the Bristol Bay region, Cold Bay, Unalaska, Sand Point, and the lower Alaska Peninsula subregion, see Section III.D.6.c.(8). The Chignik subregion is an integral part of the insular and peninsular Aleut, but they have more extensive relations and feel greater influences from mainland Eskimo culture than other villages in the region with the exception of Pilot Point, Port Heiden, and Ugashik. Though influenced by both cultures, the Chignik subregion is culturally, ethnically, and linguistically different from both, yet they identify themselves as Aleut. They continue to maintain their Aleut cultural values and traditions (Impact Assessment, Inc., 1982).

## 5. North Aleutian Basin Planning Area

### a. Physical Environment

#### (1) Geology

Three major structured features have been identified within this planning unit. Two are the sediment-filled Amak and Bristol Bay Basins. The third is a basement ridge which extends offshore from the Black Hills region of the Alaska Peninsula.

The Bristol Bay Basin is a structured depression which underlies most of planning unit. The basin's sedimentary section is composed mostly of Cenozoic sediments that are more than 6,000 meters thick (Marloa et al., 1980).

The Amak Basin is gentle coastal sag beneath the flat southern shelf. This elongated trough has a westward-trend parallel to the Black Hills ridge. The main center of deposition is circular in shape and filled with more than 4 kilometers of sediment.

The Black Hills ridge is an offshore extension of a structural high on the Alaska Peninsula. Onshore exposures and dredge samples indicate this high is composed of arkosic to lithic sandstones of late Ierasoic age.

#### (2) Physical Oceanography

In the North Aleutian Basin the maximum significant wave height equals about 22.5 meters (73 ft), with extreme wave heights on the order of 40 meters (131 ft). Water depths range from approximately 30 meters to just over 100 meters.

Winter ice cover is usually present only in the northernmost half of the planning area. This ice cover lasts about 40 percent of the year and reaches 80 to 90 percent coverage during the coldest times.

#### (3) Water Quality

Water quality of the North Aleutian Basin is considered pristine on the basis of limited trace metal and hydrocarbon analyses. Relevant trace metals occur in concentrations one or more orders of magnitude below applicable water quality criteria of the Environmental Protection Agency.

#### (4) Climate

The climate of the North Aleutian Basin is classified as polar marine. Mean air temperature ranges from -7 degrees C in February to 10 degrees C in August, averaging 1.4 degrees C. Scalar mean winds average 16.4 knots, peaking at 18 knots in early winter. Mean wind speed averages 20 knots or more for two months of the year.

#### (5) Air Quality

Existing air quality in the North Aleutian Basin is considered pristine. The EPA has prepared emissions inventory and ambient air quality estimates for areas in Alaska with relatively low populations, based on general emission factor relationships with local economic base and demographic data. Using this method of air quality analysis, the EPA considers the North Aleutian Basin to be in compliance with Federal ambient air quality standards. It is most likely that the area's air quality is far superior to the national and state standards. No air monitoring has been performed in the North Aleutian Basin however.

### b. Biological Resources

#### (1) Plankton

##### (a) Phytoplankton

Community structure and production have been well studied in the southeastern Bering Sea. Water column processes have been investigated for 5 years by PROBES (Processes and Resources of the Bering Sea Shelf; Goering and McRoy 1981). An annual primary production rate of 400 g C/sq.m. has been reported for midshelf waters. Of this, 65% is produced in April, May, and June. A value of 400 g C/sq.m. is high compared to the average annual shelf productivity of 183 g C/sq.m. in other oceans. Daily phytoplankton production rates as high as 5-10 g C/sq.m. have been measured during bloom periods, which are also high when compared to the daily productions of 0.4-0.9 g C/sq.m. for other oceans.

Diatoms account for the majority of phytoplankton found in open water habitat of the North Aleutian Shelf. Spring bloom-formers, especially Thalassiosira spp., are the most abundant plankton in early May. Successional species of Rhizosolenia alata and Chaetoceros spp. become midsummer dominants (Thorsteinson, 1984).

##### (b) Zooplankton

The Bering Sea zooplankton includes cladocerans, cumaceans, ostracods, and 11 species of copapods. Copapods are dominant in terms of both biomass and productivity. Bering Sea nedtonic invertebrates include amphipods, euphausiids, pelagic mollusks and polychaetes, chaetognaths, mysids, isopods, and decapods. Of these, amphipods and euphausiids are the most important food items (DOI, 1984).

#### (2) Fish Resources

Salmon, red king crab, bairdi and opilio tanner crab, pollock, halibut, yellowfin sole, a number of other flounders, and herring make up the major fisheries resources of this planning area. Distribution ranges from the continental shelf to inshore waters with many species performing seasonal migrations to reproduce or in response to changing environmental conditions. A number of these organisms also have pelagic eggs and larvae.

Salmon of all five species are the predominant group of commercial value in this area and spawning or rearing migrations of one or more species are in the area about six months, May-October annually, with the possibility also that some may rear to maturity without leaving the area. Yellowfin sole and halibut enter the area during the summer for spawning and feeding. Red king crab populations are at low ebb, but tanner crab, bairdi and opilio support a commercial fishery.

### (3) Marine Mammals

Sea otters, northern furseals, Pacific walrus, Steller sealions, and Pacific harbor seals are the most abundant marine mammal species in the southeastern Bering Sea and this planning area. A few to several thousand spotted and ribbon seals also occur during the ice cover. Major concentrations of the estimated 20,000 sea otters present in the planning area occur along the northern coast of the Alaska Peninsula from Unimak Island east to Port Moller. The 871,000 northern fur seals that breed on the Pribilof Islands frequent the western portion of this planning area during the summer as well as spring and fall migrations. Approximately 15 to 30 percent (38,000 to 75,000) of the Pacific walrus population occur within this planning area most of the year. Large numbers of walruses overwinter in northern Bristol Bay and Kuskowin Bay.

Major summer haulout areas are located on Round Island (north Bristol Bay) and Cape Seniavin along the Alaska Peninsula coast. Approximately 100,000 to 130,000 Steller sealions occur in the southern Bering Sea. A major breeding-pupping site occurs in the planning area on Anak Island with other large haulout locations in northern Bristol Bay. An estimated 40,000 Pacific harbor seals occur in the planning area with major breeding-pupping sites located along the north side of the Alaska Peninsula at Izembeck lagoon, Port Moller, Port Heiden, Ugashik and Egegik Bays.

The most commonly observed species in this planning area include minke, killer, and beluga whales and the harbor and Dall's porpoises. Other species including the short-finned pilot whale, Pacific white-sided dolphin, Bering Sea beaked whale, Goosebeak whale, and giant bottlenose whale have been observed infrequently in or near the planning area. Minke whales are most frequently observed feeding in lagoons and coastal waters along the north shore of the Alaska Peninsula from March through December. Killer whales (also believed to be year-round residents) are most frequently encountered between April and October. Although they are most often found nearshore, they have been sighted throughout Bristol Bay. Belugas occur in Bristol Bay year-round, and are found in association with the seasonal pack ice in winter and early spring. The Bristol Bay summer-resident population which uses Kivchak Bay extensively is estimated at between 1,000 and 5,000 individuals. The migratory movements of Dall's porpoise are not well known, but they are believed to have local migrations along the coast and seasonal onshore/offshore movements through the planning area where they have been observed year-round. Harbor porpoises may inhabit the area year-round, but are most commonly observed in the summer months in coastal environments such as bays, harbors, and river mouths.

### (4) Coastal and Marine Birds

An estimated 1.9 million seabirds occupy 64 colony areas in the North Aleutian Basin lease area during the breeding season (April-November). Outstanding concentrations are located in northern Bristol Bay at Capes Newenham and Peirce and in the Walrus Islands (Sowls et al., 1978; North Aleutian Basin, Sale 92, DEIS, 1984). Elsewhere, colonies are few and small. Most abundant species are kittiwake, murre, tufted puffins and cormorants. In winter, approximately one-half of Bristol Bay becomes unavailable to birds due to ice cover. Overwintering waterfowl and seabirds (mainly alcids) tend to concentrate along the ice front and in nearshore areas. In spring, pelagic densities generally are less than 100 birds/sq.km. except where flocks of early-arriving southern-hemisphere shearwaters elevate these values to 245/sq.km. (Gould et al., 1982). Alcids generally are the most abundant seabirds represented. Nearshore densities in northern Bristol Bay may exceed 200-400 birds/sq.km.; waterfowl and alcids are most abundant (Arneson, 1980). Lagoons along the north shore of the Alaska Peninsula are important in both spring and fall as staging areas for migrant waterfowl and shorebirds; most of all of several species populations may stop in this area during migration. Hundreds of thousands of birds are present and densities can exceed 800 birds/sq.km. From late spring to fall, shearwaters account for the highest densities recorded (as many as 2,457 birds/sq.km.), especially near the 50 m isobath. Alcid density of 465 birds/sq.km. is recorded near the large northern Bristol Bay colonies in summer.

### (5) Endangered and Threatened Species

#### (a) Whales

All eight endangered whale species may at some time occur in the North Aleutian Basin planning area. Blue, sei, sperm, bowhead and right whales prefer other habitats than those found in this area and therefore seldom occur in this area. Habitat preference may be based on physical characteristics and/or prey density and diversity. Fin whales are occasionally sighted in this area although they are more likely to be in the St. George Basin planning area. Humpbacks historically were more abundant in this area, concentrating in the Cape Newenhan region of Bristol Bay. They are still occasionally sighted in the North Aleutian Basin planning area. The nearshore areas are heavily utilized by gray whales. The primary spring and fall migratory routes occur within a few miles of the Alaska Peninsula. A portion of the population remains to feed during the summer mostly in Port Moller/Nelson Lagoon, Port Heiden, Izembek Lagoon, and Ugashik Bay. Gray whales are benthic feeders predominantly taking crustaceans which live in the upper centimeters of the sea floor.

#### (b) Birds and Plants

Four threatened or endangered bird species may occur within or near the planning area. The short-tailed albatross is highly mobile and probably occurs sporadically in the planning area (see Section III.D.1.b.(5)). The

American peregrine falcon and arctic peregrine falcon may occur within or adjacent to the planning area in low numbers during their spring and fall migrations. There have been unconfirmed sightings of fall migrating Aleutian Canada geese at Unimak Island; however, studies since 1974 have failed to confirm these sights suggesting that the geese migrate directly over water from the nesting islands to wintering areas in California and Oregon (Biological Opinion, FWS, November 4, 1983). The Eskimo curlew was historically found adjacent to the planning area; however, it has not been sighted near the planning area for decades and is therefore unlikely to occur in the area.

There are no listed or candidate plant species adjacent to the planning area.

### c. Socioeconomic Environment

#### (1) Employment and Demographic Conditions

Jobs in commercial fishing and seafood processing constitute by far the largest source of civilian wage and salary employment. This employment increased from 6% of all wage and salary jobs in 1969 to 29% in 1980. It should be noted that this is primarily all seasonal (May-Sept) work. Federal and State government are the next largest employer.

Population in the area has increased from 671 in 1960 to 1,442 in 1980. This is a 114.9 percent increase in civilian population.

#### (2) Coastal Land Use

The majority of land adjacent to the North Aleutian Basin lease offering area is under State of Alaska, Native corporation, or Federal ownership. Most state lands occur along the northern coast of the Alaska Peninsula where the state has established a number of special management areas in coastal regions to manage and protect important wildlife resources. These include two game refuges (Izembec and Cape Newenharm), five critical habitat areas (Port Moller, Port Heiden, Cinder River, Egegik, and Pilot Point), and the Walrus Island State Game Sanctuary. Village native corporations own substantial tracts of land in the Cold Bay, Port Moller, Port Heiden, Pilot Point, Egegik, Nakek/King Salmon, Dillingham, and Togiak areas. Federal lands in the region occur in the Togiak, Alaska Peninsula (Unimak Island) and Izembec National Wildlife Refuges which are managed by the U.S. Fish and Wildlife Service.

Residential, commercial, and industrial developments are primarily located in the 38 communities in the Bristol Bay Region. Land uses away from communities primarily center around recreation and subsistence uses.

#### (3) Commercial Fisheries

The commercial fisheries of the planning area are almost entirely American; foreign fleets are limited to harvest of groundfish from the western portion and to a joint-venture fishery for Pacific cod wherein American fishing vessels sell their catch to floating foreign processing vessels. The salmon fishery utilizes drift and set gillnets, usually within three miles of the beach. Offshore groundfish are harvested by bottom and midwater trawls. Halibut, sablefish, and cod are caught with longlines. A domestic fishery using pots, harvest tanner crab; the former red king crab fishery of this area is closed due to as yet undetermined declines in this population. Herring are caught during late spring from their nearshore spawning areas with drift gill nets and purse seines. The sac roe and roe-on-kelp is processed for export to Asian markets; Some herring are also frozen for bait.

The Bristol Bay fishery is the largest salmon fishery in the world. From 1978 through 1982, the Bristol Bay commercial catch averaged over 135 million pounds per year. The Alaska Peninsula catch (the smaller fishery) averaged 57 million pounds per year. In addition, the two fisheries provide the local people with a minimum of 1.1 million pounds per year in subsistence harvests. Between 1979 and 1981, this subsistence-caught salmon, the region's dietary mainstay, amounted to at least 650 pounds per year for each of the 1,700 households in the region.

The Togiak herring fishery is actually three fisheries in one: purse-seine sac-roe, gillnet sac-roe, and roe-on-kelp. The purse-seine sac-roe fishery is the most lucrative, accounting for two-thirds of the total value of the fishery in 1982.

A huge difference in average gross earnings exists in the three herring fisheries. Since 1977, the average purse-seine fisherman, who usually lives outside the region, has grossed an average of $30,000 per year fishing sac-roe. On the other hand, the average gillnet fisherman, who is usually from Bristol Bay, has brought in a fraction of that at $5,500 per year. The roe-on-kelp fisherman, most often from Togiak, has brought in a mere $660 per year.

The Alaska Peninsula fishery is a new and developing fishery with very small catches compared to Togiak. The South Peninsula has winter food-bait and summer sac-roe fisheries, and the North Peninsula has a sac-roe fishery.

In 1982, the first year of the South Peninsula's food-bait fishery, all 1.1 million pounds of food-bait herring were taken from Stepovak Bay due north of the Shumagin Islands.

The Bering Sea tanner crab fishery includes the tanner crab taken in the North Aleutian Basin. Table III-27 and Figure III-23 show the harvest in the North Aleutian Basin since 1977-1978. Since 1977-1978, about half of the Bering Sea tanner crab has come from the North Aleutian Basin. Of this, roughly 70 percent has been taken within the boundaries of the lease sale area.

The tanner crab harvest in the North Aleutian Basin has declined sharply since landings peaked at 54 million pounds in 1979-1980. In 1982-83, the catch was less than 5 million pounds (Table III-27, Fig. III-23).

The origin of king crab catches during the 1977-1982 base period was 68.6 percent from the North Aleutian Basin, 29.6 percent from the St. George Basin, and 1.7 percent from the Norton Basin. The importance of the North Aleutian and St. George Basin lease sale areas is shown by the fact that, together, they accounted for 98 percent of the red king crab harvest, with over two-thirds of the total coming from the North Aleutian Basin lease sale area alone (Natural Resource Consultants, 1984). Table III-29 and Figure III-28 show the red king crab catch in the North Aleutian Basin for recent years. In 1983-1984, the Bristol Bay red king crab season was closed due to the very poor condition of the resource.

Many diferent species of groundfish, also called bottomfish, are caught in the North Aleutian Basin, primarily by foreign fishermen but increasingly by joint U.S./foreign ventures. Only a small part of the total annual groundfish catch in the eastern Bering Sea comes from the North Aleutian Basin. Since 1973, of the 1 to 2 million metric tons harvested each year from the Bering Sea, an average of 55,000 metric tons, or less than 5 percent, has come from this area. For further detail refer to the FEIS for OCS Sale 92, the North Aleutian Basin.

### (4) Recreation and Tourism

Recreation and tourism in the area surrounding the North Aleutian Basin area is limited except in the areas around Lake Clark and Lake Iliamna, Cold Bay and Bethel. These areas provide transportation services to wild rivers and scenic landscapes. Hunting and fishing experiences attract most people to these areas. The resources are similar to those mentioned in recreation and tourism sections for the St. George Basin and for the Eastern part of the Cook Inlet and Kodiak Island.

### (5) Archaeological Resources

Archaeological resources of the North Aleutian planning area are mainly prehistoric sites, historic sites, and shipwrecks. These resources comprise the remains of the material culture of past generations of people. They are also basic to, and have implications for, the nonmaterial culture such as beliefs, knowledge, art, customs, property systems and other social aspects of culture. Three categories of archaeological resources of the North Aleutian area are: Offshore, onshore, and shipwrecks. Offshore, in the lease area the lease blocks have generally low-medium probability of human habitability. Onshore, only one site XPM-001 is a National Register Site. Onshore areas have much more potential than offshore areas. Prehistoric and historic people occupied the northern and southern coastal areas of the Alaska Peninsula. Several quadrants -- on the Pacific Ocean and Bristol Bay coasts--contain traditional hunting and fishing sites which are sources of valuable archaeological information. These are Simeonoff Island--11 sites; Stepovak Bay--7 sites; Port Moller--27 sites; Falso Pass--25 sites; Cold Bay --23 sites; Chignik--27 sites; Sutwik--3 sites; and Unimak Pass--55 sites. The archaeological sites in the Port Moller area reveal prehistoric subsistence patterns such as remains of sea mammals, land animals, fish, shells, sea urchins, and birds. These sites are clues to the wide variety of species used by ancient people. More detail on the region's cultural resources may be obtained from the Alaska Heritage Resources File (1980). Other cultural information about prehistoric resources and shipwrecks is given in OCS Technical Paper No. 2 (Tornfelt 1980).

### (7) Subsistence-Use Patterns

Specific communities in the North Aleutian Planning area which could be affected by oil development are Cold Bay, Unalaska and Sand Point where support terminals could be placed. In the Bristol Bay region as a whole, salmon, caribou and moose were singled out as the most important subsistence resources to almost all of the villages in the region. Caribou is most highly used per household in the Iliamna and Upper and Lower Alaska Peninsula subregions. In Sand Point caribou and salmon are the most important subsistence resources. The subsistence salmon harvest in Sand Point averages about 50 a year per household. Subsistence has no history in Cold Bay; the urban oriented residents do not practice food production in any intensive way beyond recreational hunting and fishing. In Unalaska, salmon is the most important resource for the entire population. Beyond that, halibut and shellfish are preferred by non-Natives, where as halibut and seal or sea lion are most favored by the Native population. The entire community uses at least some local fish and game resources, but such resources generally are used to a greater extent in the diet of Native households (ranging from 20-50%) and cover a wider range of resources than those used by the non-Native community (North Aleutian Basin Sale 92, DEIS, USDOI, 1985).

False Pass and Nelson Lagoon could also be affected. In terms of total pounds of protein harvested from local resources, caribou is the most important resource; salmon is the second most important resource. Caribou harvests are highest in False Pass (6 to 10 animals a year per household) and lowest in Nelson Lagoon (2 to 4 a year per household). Local harvesting of caribou has increased slightly in recent years due to better access with three-wheel Hondas. The subsistence-salmon harvest ranges from a low of 50 salmon per household per year in Sand Point to a high of 200; 150 to 200 per year in False Pass; 75 to 130 in Nelson Lagoon; and 50 to 150 per household per year in King Cove. Estimates of the total protein harvest from subsistence resources in the region ranges from 40 (Sand Point) to 60 (False Pass) percent (Earl R. Combs, Inc., 1982).

### (8) Sociocultural Systems

The Bristol Bay region is a culturally diverse area. Villages in the Bristol Bay region are predominantly Alaska Native with the exception of Cold Bay, King Salmon, and Iliamna. Villages in the Togiak subregion and the Nushagak River villages are based on traditional Yupik cultures whereas the upper and lower Alaska Peninsula is based on traditional Aleut culture blended with Russian and Scandinavian influence. Despite the diversity, there are still similarities, particularly in the role of kinship in organizing work, leisure, household formation, and ritual activity. The extended family has tended to give way to the nuclear family in the past 20 years. The most important values found throughout the region are those associated with the ideology of subsistence and commercial fishing as a means of livelihood. Within the region, Cold Bay, Unalaska, and Sand Point are the communities most likely to be affected by oil development. Unlike other communities in the region, Cold Bay is almost entirely a "Euro--American" community, with a population possessing values comparable to those of the larger American culture. The population is relatively transient with few family units and a disproportionate number of single males. There is no traditional subsistence culture nor values placed on subsistence as a part of their heritage. Sand Point has approximately 57% Natives and has a strong fishing oriented culture. Unalaska is a culturally diverse community with a majority of transient fishermen or laborers. The community has been divided between the traditional Aleut community in Unalaska and the seafood processing area in the Dutch Harbor area. Cultural values and orientations vary according to the social group ranging from traditional Native values to values of the larger American culture (North Aleutian Basin DEIS, USDOI, 1985).

### (9) Transportation

Air support for efforts in the North Aleutian Basin is expected to primarily issue from the airfield at Cold Bay (see discussion in Shumagin section), while marine support is expected to proceed exclusively from the Unalaska/ Dutch Harbor area. The City of Unalaska is host to a vigorous fishing industry and has numerous docks dedicated to the fish processing industry. The area currently has one 16 hectar oil support facility, constructed for exploration activities associated with lease Sale 70 and other pending OCS sales. There are indications that other support bases may be constructed within Unalaska area as exploration activities in the Bering Sea continue.

## 6. St. George Basin Planning Area

### a. Physical Oceanography

#### (1) Geology

The Bering Shelf is described as a broad continental platform that is under-lain by deformed Mesozoic and Cenozoic rocks (Marlow et al., 1979). As the result of uplift before the end of the Mesozoic era, followed by extensive rifting and regional subsidence, a series of basement ridges and basins, such as the St. George Basin and the Pribilof Ridge, were formed along an axis that is parallel to the Bering Sea margin. The St. George Basin is a long narrow feature that is approximately 300 kilometers in length and 30-50 kilometers wide. It is filled with over 10 kilometers of mostly Cenozoic sedimentary deposits.

The Pribilof Ridge is a basement feature of presumed shallow-water Iuraisic rocks that form the structural underpinnings for the outer shelf edge (Cooper et al., 1982).

South and southwest of the shelf edge lies an area known as the Unmak Plateau region. This flat-top feature lies in 2,000 meters of water and is underlain by 3 to 5 kilometers of flat-lying sediment.

#### (2) Physical Oceanography

In the St. George Basin the maximum significant wave height equals about 22.5 meters (73 ft.). Water depths range from approximately 40 meters to over 2000 meters off the shelf break.

Winter ice cover is usually present only in the northern two thirds of the planning area. This ice cover lasts about 40 percent of the year and reaches about 90 percent coverage during the coldest times. Long term circulation is a weak intermittent mortheast flow along the north side of the Alaskan Peninsula.

#### (3) Water Quality

Water quality of the St. George Basin is considered pristine on the basis of limited trace metal and hydrocarbon analyses. Relevant trace metals occur in concentrations one or more orders of magnitude below applicable water quality criteria of the Environmental Protection Agency.

#### (4) Climate

The climate of the St. George Basin is classified polar marine. Mean air temperature ranges from -5 degrees C in February to 9 degrees C in August, averaging 1.6 degrees C. Scalar mean winds average 17 knots, peaking at 22 knots in October. Mean wind speed averages 20 knots or more for five months of the year.

#### (5) Air Quality

Existing air quality in the St. George Basin is considered pristine. The EPA has prepared emissions inventory and ambient air quality estimates for areas in Alaska with relatively low populations, based on general emission factor relationships with local economic base and demographic data. Using this method of air quality analysis, the EPA considers the St. George Basin to be in compliance with Federal ambient air quality standards. It is most likely that the area's air quality if far superior to the national and state standards. However, no air monitoring has been performed in the St. George Basin.

### b. Biological Resources

#### (1) Plankton

##### (a) Phytoplankton

Diatoms dominate the communities in most of the area and during most seasons. Microflagellates and chrysophyte Phaeocystis poucheti, however, are in some regions and at certain times important components of the phytoplankton community. Microflagellates are reported to make up the major portion of the phytoplankton populations in the winter and early spring before the major diatom bloom. Phaeocystis poucheti appears to be a regular feature of the outer shelf and shelf-break region of the southeast Bering Sea.

The water associated with melting seasonal ice is characterized by large numbers of pennate diatoms. Many of these species probably also grow in seasonal sea ice.

The Bering Sea ice-edge community characteristically contains large numbers of chain-forming diatoms, many of which form flat ribbon-shaped colonies. Some of the species are neritic centric diatoms, and others are pennate ice plankton.

The dominant phytoplankton species of the icefree eastern Bering Shelf community varies with season. During the early spring the high nutrient waters of the mid-shelf domain contain dense populations of fast-growing small centric diatoms dominated by species of Chaetoceros and Thalassiosira. In late spring medium-sized long-chain-forming species of Chaetoceros are abundant along with Rhizosolenia alata. In the outer shelf region Phaeocystis poucheti is at times and in certain regions almost totally dominant. (Hood & Calder 1981)

##### (a) Zooplankton

Three generally recognizable copepod groupings have been suggested as characteristic of water masses defining the upper 200 m of the Bering Sea: (1) an oceanic assemblage dominated by the interzonal seasonally migrating copepods Calanus cristatus, C. plumchrus, and Eucalanus bungii, often accompanied by Metridia pacifica (= lucens); (2) an inner eastern shelf community represented by Calanus glacialis and Acartia longiremis in the south and Eurytemora herdmani, Epilabidocera amphitrites, and Tortanus discaudatus over the northern shelf; and (3) a mixed community around the transition between oceanic and shelf waters along the eastern shelf break. The distributions of several common euphausiids and amphipods are also cited as being correlated with the general structure of the major water masses (Hood & Calder 1981).

### (2) Fish Resources

St. George Basin Planning Area fisheries are best characterized by the large-scale foreign trawling effort for ground fish along the continental slope from north of Unimak Pass to the Pribilofs. The walleye pollock is the major groundfish species harvested at this time, with quantities of yellowfin sole and other flounders, turbot, Pacific cod, and sablefish also taken. Blue and brown king crab occur in the area. The pandalid shrimp resource is much depleted. While salmon migrate through the area enroute to spawning areas and probably also as immatures enroute to North Pacific rearing areas, the timing, magnitude, and distribution of these runs is largely unknown.

### (3) Marine Mammals

Approximately 73 percent (871,000) of the world's population of northern furseals breed and pup on the Pribilof Islands and forage within the planning area along the shelf break during the summer. Approximately 14,000 Steller sealions are present in the planning area with major pupping-breeding sites located on the Pribilof Islands, Bogoslof Island, and other sites on the eastern Aleutians. Of the estimated 54,000 Pacific harbor seals in the southern Bering Sea, about 11,000 occur in the St. George Basin planning area. Breeding and haulout sites are widely dispersed on the eastern Aleutian Islands with about 1,000 present on the Pribilof Islands. Sea otters are present in the planning area with high densities present near Unimak Pass and Avatanak Island of the eastern Aleutians. Of the total Pacific walrus population (250,000) tens of thousands occur during late winter-early spring offshore in the pack ice front within the planning area. Major winter-spring breeding concentrations occur offshore north and east of the Pribilof Islands. Approximately 10,000-20,000 spotted and ribbon seals occur within the planning area during ice cover.

The most commonly observed whale species in this planning area include the minke, killer, and beluga whales and the harbor and Dall's porpoises. Less frequently observed species include the short-finned pilot whale, Pacific white-sided dolphin, Bering Sea beaked whale, goosebeak whale, and giant bottlenose whale. Minke whales apparently occur in the Bering Sea year-round with concentrations near the Pribilof Islands during the summer. Killer whales are believed to be year-round residents, but are most frequently observed between April and October. They are abundant just south of the Pribilof Islands along the continental shelf and slope, and, several observations have been made far offshore and in waters up to 2,000 meters deep. The Bristol Bay-Bering Sea stock of belugas is estimated at 9,000 individuals. Belugas have been observed near the Pribilof Islands, but are generally characterized as a nearshore/estuarine species during the summer and is closely associated with the pack ice edge in winter. Dall's porpoise are most common in waters over 100 meters deep with concentrations along the shelf break from Unimak Pass to the Pribilofs from June through August. Bering Sea beaked whales have been observed in waters 730 to 1,280 meters deep off the Aleutian Islands. There is a summer concentration area for the four most commonly observed species generally encompassing the southern half of the planning area.

### (4) Coastal and Marine Birds

An estimated 5.0 million seabirds occupy colonies in the St. George Basin lease area during the breeding season (Sowls et al., 1978). Outstanding concentrations are found on the Pribilof Islands (2.8 million) and the eastern Aleutians (2.2 million). Colony locations are shown in the St. George Basin (Sale 89) DEIS (1984). Least, crested, and parakeet auklets, murres, puffins, kittiwakes, cormorants and fulmar are the most abundant species in the Pribilofs; most of the world's population of red-legged kittiwakes breeds here. In the eastern Aleutians, auklets are relatively uncommon and greater numbers of tufted puffins are present. Additional species here include storm-petrels, guillemots, murrelets and the endemic whiskered auklet.

Pelagic densities may be substantial from April through October, especially over the shelf and shelfbreak. Spring densities, probably including overwintering birds and migrants whose northward progress is delayed by pack ice, range as high as 1,048 birds/sq.km. (mainly alcids).

In summer, high densities to 655 birds/sq.km., especially alcids) occur in the vicinity of large colony concentrations in the Pribilofs and eastern Aleutians (Gould et al., 1982). Contributing substantially to densities in the latter area are large blocks of nonbreeding southern-hemisphere shearwaters, which also are present in large numbers near the 50 m isobath in the northern part of the lease area (671 birds/sq.km.) and to the east (1,318 birds/sq.km.). Flocks numbering well over 1 million individuals have been observed. Fulmars are common in the Unimak Pass area and, together with other species, account for a density of 224 birds/sq.km.

In fall, many species move from colonies to the shelfbreak where densities, including shearwaters, can exceed 1,100 birds/sq.km.; in the northern area, shearwater densities exceeding 1,600 birds/sq.km. are recorded.

In winter, murres and other seabirds and waterfowl concentrate near and within the ice front. Murre densities as high as 10,000 birds/sq.km. have been observed and 1000 birds/sq.km. are not uncommon (Divoky, 1981). The eastern Aleutians are an important overwintering area for several species of waterfowl and seabirds.

### (5) Endangered and Threatened Species

#### (a) Whales

Blue and sei whales seldom migrate north of the Aleutian Islands so their appearance in the St. George Basin would be a rare occurrance. Likewise, the bowhead whale generally winters north of this area but heavy winter ice may force bowheads further southeast and into the planning area. One right whale was sighted in the planning area but they are most likely to be found in the western portion of this area (triangle bounded by St. Matthew, Nunivak and Atka Island) from June through August. Gray whales migrate through the area to the Pribilof Islands along a secondary migratory route. A portion of the fall migration bisects the eastern portion of the planning area. Gray whales are in the area from late March through June and October through December except for the small summer population around the Pribilof Islands. Sperm whales are most likely to be in the western portion from the shelf break west. Humpbacks may range throughout the planning area and scattered accumulations of humpbacks have been observed to the east of the Pribilofs and north of Unalaska Island. They are most frequently seen from May through November. A summer feeding area for fin whales occurs along the shelf break between Unimak Pass and the Pribilof Islands. The North Pacific population is estimated between 17,000 to 21,000 individuals and of those approximately 5,000 enter the Bering Sea during summer. They are present for 6 to 8 months in the planning area beginning as early as April.

#### (b) Birds and Plants

Two endangered bird species, the short-tailed albatross and Aleutian Canada goose, are likely to occur within or adjacent to the planning area (See Section III.D.1.b.(5)). The Eskimo curlew was found historically on the Pribilof Islands within the planning area; however, the species has not been sighted in the area for decades and is therefore presumed to be absent.

There are no plant species adjacent to the planning area listed as threatened, endangered, or considered candidates for federal listing.

### c. Socioeconomic Environment

#### (1) Employment and Demographic Conditions

Refer to Section III.D.1.c.(1) for general information. The largest source of employment, apart from the military, is the commercial fishing industry. Manufacturing employment (fisheries) increased 6% of all wage and salary jobs in 1969 to 29% in 1980. In 1980 wage and salary jobs in the Aleutian Islands Census Division averaged 5,867 jobs. In addition there were about 756 non-wage (shores) fishermen. Additional jobs are in State, Federal and native corporation employment. Population is concentrated in Unalaska, however in the Aleutian Islands there are about 8,500 people.

#### (2) Coastal Land Uses

With the exception of areas selected by the State of Alaska or various village and regional corporations, the bulk of federal lands in the Alaska Peninsula is located in the Izembek and Alaska Maritime National Wildlife Refuges.

Many small islets and rocks along the Alaska Peninsula and Aleutian Islands, public lands not selected or otherwise withdrawn in the Aleutian Islands, and selected seabird cliffs on St. George and St. Paul Islands and Otter and Walrus Islands in the Pribilofs are included in the Alaska Maritime National Wildlife Refuge.

Within the Aleutian Island and Pribilof Island areas, there is a relatively small amount of developed land. Aside from lands within the village and urban areas of the first and second class cities, land development is generally not occurring. Land use away from village areas is primarily limited to occasional recreational use, including sport fishing, some subsistence use, and seasonal residences. Commercial fishing is very important and occupies much of the land near the villages.

The impetus for private development in the Aleutian and Pribilof Islands area could come from four sources: the regional Native corporation, the Aleut Corporation; individual Native village corporations; private individuals, singly or in small groups; and private industry, such as the commercial fishing industry or the oil and gas industry. Generally speaking, the majority of available land (that is, land not already developed and without environmental hazards making development unfeasible) is held by individual Native corporations. There is not a large amount of land available that is not already developed or that does not have severe environmental constraints associated with it.

### (3) Commerical Fisheries

Foreign vessel trawling for groundfish, pollock, yellowfin sole, turbot and other flounders (excluding halibut) is the major commerical fishery in this planning area. The domestic fisheries consist largely of a pot fishery for the blue king crab, brown king crab, and some effort on Korean hair crab near the Pribilofs. At this time the total metric tons of fish and shellfish harvested from the St. George Basin exceeds that from all other Alaskan fisheries, with pollock the major component of this total tonnage.

### (4) Recreation and Tourism

The St. George Basin has abundant recreation and tourist resources. These resources are unique compared to other areas of the U.S. and even Alaskan resources. For example, the Alaska Peninsula and the Aleutian Chain coastlines contain more volcanoes per linear mile than most coastlines in the world. The Aleutian Chain has fewer trees per thousand miles than any area of the United States which is bounded on two sides by the ocean. It has the smallest spruce forest of any major region in the United States. The Pribilof Islands and the Isembeck Lagoon offer bird and animal observation different from any in the world.

### (5) Archaeological Resources

Archaeological resources of the St. George Basin dated back to about 6500 B.C. The surrounding continental shelf and onshore area, and possibly the south side of the Alaska Peninsula have been habitats of prehistoric and historic people for thousands of years. There are valuable known and undiscovered archaeological resources in these areas. The area around the Pribilof Islands has potential for offshore resources and so does the Bristol bay area and the area offshore north of the Alaska Peninsula (Dixon, et al). However, examination of landforms and prehistoric shore line have left only an area just north of the Alaska Peninsula as having high probability of human habitation offshore. (See MMS Cultural Resource Reports by Schneider and Friedman, 1983). There are a number of shipwrecks in the St. George Basin area. No precise locations are available for these (see Tornfelt, 1982).

### (6) Transportation

Oil and gas exploratory activities within the St. George Basin are expected to be supported from Cold Bay (air support) Unalaska (marine support) and St. Pavi Island (both air and marine support). Both Cold Bay and Unalaska currently could fulfill their perceived roles supporters of OCS transportation and logistics needs; however, St. Pavi Island has basic infrastructure and would require construction of many necessary facilities.

### (7) Subsistence-Use Patterns

Although similarities exist in the types of resources used by local residents in the area, considerable differences and variations of importance exist among communities using the resources. Salmon are a primary subsistence resource and are used by the entire population, in the area except for the Pribilof Islands, where emphasis is given to the more readily available halibut. Crab is used as a subsistence resource in the larger communities of Unalaska, King Cove, and Sand Point because of the commercial fishing in those towns. Although marine mammals are available throughout the area, they are not used for subsistence purposes to any great extent by the communities east of Unimak Pass, with the exception of King Cove and Belkofski. Fur seals are a primary subsistence resource harvested solely on the Pribilof Islands where all residents make use of them. Sea lions are also of primary importance on the Pribilof Islands and in Nikolski, and seals are used to a significant extent in Nikolski and in Akutan by most of the population of these villages. Residents of the Pribilof Islands also place primary importance on a wide variety of birds and bird eggs, whereas intertidal organisms and vegetation (reef as well as beach food) are significant resources year-round in Nikolski. Large land mammals, except for domestic sheep and reindeer, are available locally only on Unimak Island and the mainland. Unlike other communities in the region, most urban-oriented residents of Cold Bay do not participate in subsistence hunting and fishing St. George Basin Sale 70 FEIS, USDOI, 1982).

### (8) Sociocultural Systems

The Aleutian-Pribilof Islands sociocultural systems are distinctly made in the tradition of the Aleut. Hunting, fishing, and gathering continue to be crucial to their cultural experience. Family patterns, sex and age roles, community organization, leadership, and social life still continue to be influenced by subsistence requirements and the resources of the maritime environment. Although there are differences in the cultural traditions of the Aleuts in the St. George Basin area, kinship forms the basis for their social organization and cultural values and orientations continue to be oriented towards their Aleut subsistence heritage. The Pribilof Aleuts have had a unique cultural experience through involvement in the commercial fur seal harvest, yet the communities remain Aleut in character and oriented towards a subsistence lifestyle. For a specific discussion of Unalaska, Cold Bay, and Sand Point, see Section III.D.6.c.(8).

## 7. Navarin Basin Planning Area

### a. Physical Environment

#### (1) Geology

The Navarin Basin planning area consists of the following three physiographic provinces: (1) the relatively flat continental shelf, which extends to the 150-meter isobath; (2) the steep continental slope, which lies between the 150- and 2,800-meter isobath; and (3) the continental rise, which extends from the base of the slope to depths greater than 3,000 meters. The planning area includes three basins separated by basement ridges that trend northwest. The largest basin, which is adjacent to the U.S.-U.S.S.R. Convention Line of 1867 in the northern part of the planning area, contains a section of sedimentary rocks that is 12 to 15 kilometers thick; the sedimentary sections in the other two basins are thinner. Possible traps for petroleum include: (1) the anti-clinal structures of the largest basin; (2) the structures associated with growth faults along the flanks of the two southern basins; (3) the strata draped over basement rocks; and (4) the pinchouts in basin fill. Little is known about possible source beds in the planning area because only a single Continental Offshore Stratigraphic Test (COST) Well has been drilled in the planning area--in 1983.

#### (2) Physical Oceanography

In the Navarin Basin the maximum significant wave height equals about 20.5 meters (67 ft.). Water depths increase towards the southwest corner of the planning area, ranging from about 60 meters to over 3,000 depth. Currents are likely to be weak and directed to the north and northeast.

The ice cover lasts about 50 percent of the year and averages 90 to 100 coverage during the coldest times north of the shelf break. The basin can be counted on to be ice-free only during July through October.

#### (3) Water Quality

Water quality of the southern Bering Sea is considered pristine on the basis of limited trace metal and hydrocarbon analyses. Relevant trace metals occur in concentrations one or more orders of magnitude below applicable water quality criteria of the Environmental Protection Agency.

#### (4) Climate

The climate of the Navarin Basin is classified as polar marine. Mean air temperature ranges from -8°C in February to +9°C in August, averaging +0.4°C. Scalar mean winds average 16 knots, peaking at 20 knots in October through December.

#### (5) Air Quality

Existing air quality in the Navarin Basin is considered pristine. The EPA has prepared emissions inventory and ambient air quality estimates for areas in Alaska with relative low populations, based on general emisssion factor relationships with local economic base and demographic data. Using this method of air quality analysis, the EPA considers Aleutian Islands election districts, which comprise the closest onshore area to this basin, to be in compliance with Federal ambient air quality standards. It is most likely that the area's air quality is far superior to the national and state standards. However, no air monitoring has been performed in the Navarin Basin.

### b. Biological Resources

#### (1) Plankton

##### (a) Phytoplankton

The Navarin Basin area, being further north than the Aleutian Basin region, more frequently contains the southernmost edge of the ice pack. The melting of the ice edge promotes high primary production in the spring by increasing the stability of the water column. Production at the ice-edge may range from 2.2 milligrams of carbon per square meter per day (McRoy and Goering, 1974) to 15 milligrams of carbon per square meter per day (Alexander and Chapman, 1981). These values, although obtained outside of the Navarin Basin area, are probably representative figures.

As in other Bering Sea regions, the patterns of phytoplankton growth, biomass and species composition apear to be directly related to the distribution and abundance of oceanic and shelf herbivores (see Aleutian Basin). The Navarin Basin region transects depths of greater than 2000 meters to approximately 50 meters and thus contains oceanic, outer-shelf and middle-shelf zones, which are defined by hydrographic conditions.

##### (b) Zooplankton

Zooplankton and micronekton assemblages encompass an oceanic and outer-shelf community (composed primarily of large calanoid copepods and euphausiids) and an overlap zone, where the oceanic/outer-shelf community mixes with representatives of the middle-shelf/coastal community (see discussion by Cooney, 1981). In the mid-shelf region (from approximately 50 m to 100 m), phytoplankton are first dominated by small diatoms (Chaetoceros and Thalassiosira) and the haptophyte, Phaeocystis (see Aleutian Basin). These are later replaced by medium-sized diatoms (Chaeotoceros, Thalassiosira, Rhizosolenia, and Nitzchia), and in some regions Rhizosolenia alata comes to dominate. The mid-shelf group of herbivores, consisting mostly of small zooplankton, appear to be ineffective grazers of long-chain diatoms, such as Rhizosolenia alata. Thus, in the mid-shelf region, these large diatoms are not extensively grazed and they sink into the bottom water, where they support a well-developed benthic food web.

#### (2) Fish Resources

Relatively little information is available concerning benthic communities within the Navarin Basin. Some information exists concerning potentially commercially important shellfish, and studies by Stoker (1981) have provided some information on infaunal assemblages. The Navarin Basin has all the Bering Sea crab species; however, in numbers, the blue king crab and tanner crab predominate. A third crab species, the gold king crab, is found here but does not enter the commercial catch in any number. Some benthic snails may be fished for by the Japanese along the eastern edge of the region. Stoker (1981), in a study of benthic infauna in the northeastern portion of the region, characterized two assemblages: one predominated by three bivalve mollusks and an amphipod, and another predominated by a polychaete, brittle star, sipunculid and a bivalve mollusk.

The Navarin Basin area is an area of high fish resources. Pacific salmon of American and Asian origin inhabit the Navarin Basin during ocean life and while migrating. Interception harvest by the Japanese high seas gillnet fishery and research nets indicates that sockeye, chinook, and chum salmon are found at least seasonally within the Navarin area, both as adults and smolt (Straty, 1975). Pacific herring school in vast numbers during the winter months, northwest of the Pribilofs and within the Navarin Basin, although the location varies somewhat depending on water temperatures and ice conditions.

The most frequently encountered (and most abundant) species of demersal fish during NMFS surveys in the Navarin Basin area were generally those also most important in the catches of the foreign fishing fleets. The average catch of these fish (kg/half-hour trawl) were as follows: walleye pollock (469), Greenland turbot (69), Pacific cod (28), flathead sole (23), rock sole (8), and yellowfin sole (3). Abundant non-commercial bottomfish consist mainly of sculpins, eelpouts, skates, and poachers.

### (3) Marine Mammals

Pacific walruses, bearded, spotted, and ribbon seals are abundant within this planning area during the ice cover season (December April) with Steller sealions and Pacific walruses common during the open water season. Some fur seals and ringed seals may occur seasonally. An estimated 225,000 or 90 percent of the Pacific walrus population migrate through or overwinter in the Navarin-St. Matthew-Hall basins during ice cover periods with hundreds hauling out on St. Matthew Island during the summer. An estimated 120,000 bearded seals occur within the eastern Bering Sea including this basin with major pupping-breeding habits present in this planning area during the ice season. About 75,000 spotted seals and 35,000 ribbon seals occur in the eastern Bering Sea (Alaskan waters) including this basin with major pupping-breeding habits present in the planning area during ice cover seasons.

The most frequently observed whale species in this planning area are the beluga, killer, and minke whales and Dall's porpoises. Killer and minke whales are year-round residents. During the summer, approximately 3,000 minke whales reside in the Bering Sea. Some calving is known to occur in the Navarin Basin. Of the estimated 3,000 killer whales in the North

Pacific population, 800 are believed to be year-round residents of the Bering Sea. After summering in more nearshore waters or in the Chukchi Sea, killer whales return to offshore waters in the Bering Sea where the sea ice determines their northern limits during the winter. Dall's porpoises are abundant along the shelf edge (as far north as 62-66°N) during the ice free period. Some calving occurs in the area in the spring and summer. Belugas inhabit the Navarin Basin in the seasonal pack ice during the winter and spring prior to migrating north to summer grounds. Several species of beaked whales are also found less frequently inhabiting the area.

### (4) Coastal and Marine Birds

While no marine birds breed in the Navarin Basin lease area, St. Matthew, Hall and Pinnicle Islands (part of the Maritime National Wildlife Refuge) are the site of a major Bering Sea colony concentration (Navarin Basin, Sale 83, FEIS, 1983). An estimated 1.44 million seabirds are present during the breeding season (Sowls et al., 1978). Average density in the vicinity of St. Matthew is 193 birds/sq.km., mainly murres and auklets (Epply and Hunt, 1984). Over the shelfbreak in the southern lease area, pelagic densities also are substantial (97 birds/sq.km.) with storm-petrels the most abundant species. Since ice covers most of the area in winter, overwintering seaducks and seabirds are concentrated in the St. Matthew polynya and the ice front. Eiders, murres and other seaducks and seabirds are abundant in these habitats. Openings in the ice front may contain densities as high as 10,000 murres/sq.km. (Divoky, 1981).

### (5) Endangered and Threatened Species

#### (a) Whales

Gray whales sighted in the Navarin Basin planning area are most likely migrating through to summer feeding areas in the Gulf of Anadyr. Gray whales prefer to feed in relatively shallow waters (20-60 m) so they probably will not be feeding in this area as most of the planning area is in water deeper than 100 m. Sperm whales number about 200,000 individuals in the North Pacific population and approximately 15,000 are in the Bering Sea during the summer months (June-September). Sperm whales feed in deep waters generally along the bottom for squid and fish. The northern most boundary of their range appears to run through the planning area from Cape Navarin to the Pribilof Islands. Bowheads will be in the area from December through March overwintering in polynyas and the broken ice field of 4-6 oktas (50-75% ice coverage). Two right whales were observed in the planning area in the summer of 1982. Right whales feed on copepods and euphauiids in the surface layers of the water column. On the rare occasion that right whales may be in the area it would most likely be between June and August. Fin whales have been observed migrating through and feeding in the planning area (February-November); some presumably overwinter in the area. Many whales in this area are migrating along the shelf break to summer feeding grounds in the Gulf of Anadyr.

#### (b) Birds and Plants

Two bird species, the short-tailed albatross, arctic peregrine falcon, and American peregrine falcon, may occur within the planning area (see Section III.D.1.b.(5)). During February and March of 1983, Fish and Wildlife Service observers reported 8 peregrine falcon sightings 2 to 125 km south and west of St. Matthew Island. The birds were apparently wintering along the ice edge where open water provided habitat for prey species. The subspecific identity of these birds is unknown, consequently these birds could be of a listed or non-listed race. Prior to these observations all evidence indicated that arctic and American peregrine falcons do not winter in or near Alaska (Biological Opinion, FWS, July 15, 1983).

No listed plant species or candidate species for federal listing occur adjacent to the area.

### c. Socioeconomic Environment

#### (1) Employment and Demographic Conditions

Refer to Section III.D.1.c.(1) for general discussion. There are no people living in or relatively near (85 to 150 miles) this planning area. Discussions of employment and demographic conditions of St. Paul, Nome and other affected towns are found in other planning area descriptions.

#### (2) Coastal Land Uses

The land areas adjacent to the Navarin Basin planning area include the Aleutian Islands, the lower Alaskan Peninsula, the Pribilof Islands, and St. Matthew Island. These lands are primarily under federal and native ownership. There is a relatively small amount of developed land within this area and aside from lands within the villages and first- and second-class cities, land development generally is not occurring. Land use away from the villages is primarily limited to occasional recreational use, subsistence use, and seasonal residences. Land use in Cold Bay and Unalaska, cities which may serve as support bases, is described in Section III.D.1.c.(2).

St. Matthew Island, a 128 square mile island included in the Bering Sea Unit of the Alaska Maritime National Wildlife Refuge, has primarily been affected by the forces of nature. The island has been uninhabited by man since prehistoric times; however, short-term uses of the island have occurred. The most visible evidence of man's presence is the remains of a small World War II meteorological-navigational installation and the remains of a few fox trapper shelters erected prior to World War II. Other than these minor remains of man's presence, the island is primarily natural in appearance.

On August 10, 1983, the Department of the Interior entered into an agreement formally transferring 4,092 acres of land on St. Matthew Island to the Cook Inlet Region, Inc., Calista Corporation, and the Sea Lion Corporation (CIRI Group) in exchange for specific selection rights and property interests held by these native corporation in the Yukon Delta and

Kenai National Wildlife Refuges. The transfer would terminate at the end of fifty years or when the island is no longer needed to support oil production activities. The transfer removes the specified land on St. Matthew Island from the protections previously afforded by the National Wildlife Refuge and wilderness systems and allows the acreage to be used as a support facility for OCS oil and gas exploration.

### (3) Commercial Fisheries

The Navarin Basin is an area of highly productive fisheries and intensive foreign fishing activity. Five foreign nations (Japan, U.S.S.R., Korea, Taiwan, and Poland) are permitted to conduct a fishery in these waters. In 1979, U.S. and foreign fisheries harvested about 1.7 million metric tons of crab, salmon, halibut, sablefish, herring and bottomfish worth over $400 million from U.S. waters in the Bering Sea. About 90 percent of this harvest now consists of demersal fish that provide a year-round fishery for foreign fleets. By the year 2000, it is anticipated that harvest of fishery resources in the Bering Sea will have increased and U.S. fisheries will have replaced all foreign fisheries in the U.S. Fisheries Conservation Zone (FCZ) of the Bering Sea.

Within the Navarin Basin area there is an extensive trawling activity along the shelf break for groundfish, principally pollock. The Basin is also a principal fishing area for a number of important non-groundfish species. The Japanese conduct their high-seas salmon gillnet fishery in and near the area. Factory fleets from Japan fish the area for Tanner crabs, and independent pot vessels harvest Tanner crabs and snails. Longliners from Japan and South Korea fish the southeast corner of the area for sablefish. The area is also the center of the highly productive Bering Sea pollock fishery, and is a principal fishing area within the Bering Sea for several other groundfish (i.e., Pacific cod, Greenland turbot, and other flounders). From 24% to 38% of all groundfish taken in U.S. waters of the Bering Sea from 1977 to 1979 came from the Navarin Basin area, including from 29% to over 42% of the entire catch of pollock in the Bering Sea. By far the greatest fishing effort in the Navarin Basin area is by the Japanese fleet, which takes 76 to 82 percent of the pollock catch, and from 77 to 100 percent of all other groundfish.

### (4) Recreation and Tourism

The potential for recreation and tourism in the Navarin Basin is very low. There is no land in the planning area, which is located a great distance from any centers of population. If a maximum case scenario is used the Pribilof Islands would be included which would increase the potential for recreation and tourism. In fact, tourism and recreational businessess have been in operation for 20 years or more on the Islands. Visitors come to see the seal harvest, the National Historic Landmark, and bird colonies.

### (5) Archaeological Resources

It is possible--but not very probable--that archaeological resources exist in the Navarin Basin. If such resources exist, they would be in the northeast half of the planning area, where shipwrecks from historic times may also remain. The low probability of human habitation of the area is verified in an MMS report (Jones, 1982), which states that 70 percent of the area is below the 100-meter isobath, the shoreline below which human habitation is improbable. However, use of St. Matthew Island and/or St. Paul Island for facilities to support exploration in the Navarin Basin Planning Area would involve an area of high probability of human habitation.

### (6) Transportation

Primary air and marine support for activities in the Navarin Basin may be supported by regional marine supply bases located on St. Paul Island and at Unalaska.

### (7) Subsistence-Use Patterns

As in other planning areas which are distant from any population, the closest communities with a civilian population participating in subsistence activities to the Navarin Basin are the Pribilof Islands and villages west of Unimak Pass (Atka, Nikolski, Unalaska, and Akutan) and east of Unimak Pass (Nelson Lagoon, False Pass, Cold Bay, King Cove, Belkofski, Sand Point, and Squaw Harbor). For a description of these communities, see Sections III.D.8.c.(7). The communities which could potentially serve as support bases (or be near them) for any oil development in the area probably will be Cold Bay, Unalaska, and Sand Point. For a description of the subsistence use patterns of these communities (Sand Point and Unalaska only. Cold Bay residents do not participate in subsistence activities per se.) see Section III.D.16.c.(7).

### (8) Sociocultural Systems

As with the subsistence-use patterns, see Sections III.D.8.c.(8) and III.D.6.c.(8) for descriptions of communities which could be affected in the Navarin Basin.

## 8. Norton Basin Planning Area

### a. Physical Environment

#### (1) Geology

The entire Norton Basin Planning Area overlies the continental shelf of the northeastern Bering Sea. This shelf is characterized as being broad and shallow; water depths within the planning area generally range from about 5 to 55 meters. The potential source and reservoir rocks of the Norton Basin would most likely be Tertiary in age and would overlie the Cretaceous and older basements rocks. The Paleocene rocks are the most propsective for petroleum. The thick section of sedimentary rocks in many parts of the Norton Basin could provide the source rocks, migration routes, and stratigraphic traps for petroleum. The fault-dominated structure of the basin rocks also may have produced structural traps. The arch-like structure of the strata overlying structural highs also may provide potential traps for hydrocarbon fluids. Two COST Wells and three explorations wells have been drilled in Norton Sound; the exploration wells were plugged and abandoned as apparent dry holes.

#### (2) Non-Petroleum Mineral Resources

The only known potential non-petroleum mineral resources of the Norton Basin Planning Area are sand and gravel and possible gold and tin. Accumulations of coarse sand- and gravel-size particles are relic deposits found in a thin layer overlying bedrock in the Bering and Anadyr Straits, in Sphanberg Strait, in a trough along the northwestern part of the Chirikov Basin, and along the north side of St. Lawrence Island.

Studies indicate that gold is widely dispersed in the Chirikov Basin and may be concentrated in nearshore areas that are close to onshore mineralized outcrops, in both nearshore and offshore deposits of glacial drift and near bedrock exposures on the seafloor. Onshore placer deposits of cassiterite (tin) are located near the coast in an area of the western Seward Peninsula that is adjacent to the northern part of the planning area. Information regarding offshore places in the planning area is not available to the public.

#### (3) Physical Oceanography

In the Norton Basin the maximum predicted significant wave height equals about 23 meters (76 ft.). The wave calculations, however, ignore water depth and ice cover; observed maximum wave heights are considerably less than 23 meters. Water depths are shallow, ranging from about 5 meters to over 50 meters depth. Water currents in the eastern part of the area are weakly cyclonic and in the western part flow north.

The ice cover lasts about 37 percent of the year and averages 90 to 100 percent coverage during the coldest times. The basin can be counted on to be ice-free only during late July through mid-October.

### (4) Water Quality

Water quality of the Norton Basin is considered pristine on the basis of limited trace metal and hydrocarbon analyses. Relevant trace metals occur in concentrations one or more orders of magnitude below applicable water quality criteria of the Environmental Protection Agency.

### (5) Climate

The climate of the Norton Basin is classified as polar marine. Mean air temperature ranges from -16°C in February to +9°C in August, averaging -3.4°C. Scalar mean winds average 13 knots, peaking at 16 knots in October and November.

### (6) Air Quality

Existing air quality in the Norton Basin is considered pristine. The EPA has prepared emissions inventory and ambient air quality estimates for areas in Alaska with relative low populations, based on general emission factor relationships with local economic base and demographic data. Using this method of air quality analysis, the EPA considers the Nome election district, which comprise the closest onshore area to this basin, to be in compliance with Federal ambient air quality standards. It is most likely that the area's air quality is far superior to the national and state standards. However, no air monitoring has been performed in the Norton Basin.

## b. Biological Resources

### (1) Plankton

#### (a) Phytoplankton

The Norton Basin is basically a shallow-water area, with depths ranging from less than 10 meters to about 50 meters. As in the Aleutian Basin, Navarin and St. Matthew Hall areas described, the receding ice pack causes a seasonal burst of phytoplankton productivity, which has been studied in the Norton Sound area (see Alexander and Chapman, 1981). Ice algae apparently contribute only a relatively small quantitative part to the total primary productivity of the Bering Sea (Alexander and Chapman, 1981), yet they may be quite important as a pulse of organic material available before phytoplankton blooms occur in the water column and as an early spring inoculum of algal cells to the spring, open-water phytoplankton bloom (Alexander and Chapman, 1981). Values for production at the ice-edge were given in the Navarin Basin description.

#### (b) Zooplankton

The zooplankton communities consist of a mixed oceanic/outer-shelf --middle-shelf/coastal community throughout most of the Sound and a nearshore community in the shallower nearshore areas. These communities have been described by Cooney (1981) and Neimark (1979). As in other Bering Sea regions, the sizes and life histories of zooplankton affect the pattern of utilization of phytoplankton. Because most of the Norton Sound area is dominated by smaller herbivorous zooplankton, the larger phytoplankton are not utilized and bloom in the water column, eventually settling in the benthos. Cooney (1981) estimates grazing efficiency for the middle and inner shelves to be 2 and 3 percent respectively (compared to the oceanic region where 12 to 16 percent of the phytoplankton are grazed; Cooney and Coyle, 1980; Cooney, 1981).

### (2) Benthos

Flora and fauna in the intertidal regions of Norton Sound are extremely sparse compared to intertidal communities in southeastern and southcentral Alaska (Gundlach et al., 1981). The major intertidal plants of apparent import are *Fucus* (a brown alga) and *Zostera* (eelgrass), both of which may serve as substrate for herring eggs. Collectively, the invertebrate epibenthos of Norton Basin is dominated by echinoderms. This group comprises 80% of the invertebrate biomass and over 60% of the combined invertebrate and demersal fish biomass (Wolotira et al., 1977). Starfish are the primary group of echinoderms present. Mollusks accounted for 5.1 percent of the biomass in Norton Basin, with the whelk, *Neptuna heros*, the dominant mollusk both in biomass and abundance (Wolotira, 1980). This whelk has been estimated to have a population size of 56 million snails in Norton Basin (Wolotira et al., 1977). Arthropods contributed 8.4% of the biomass and 52 species to the invertebrate benthos of Norton Basin (Jewett and Feder, 1981). Two species of king crab are found in the Norton Basin, differing in their distributions and abundances. Red king crab are found in the more central and eastern parts of the Basin, with the population in 1976 estimated to be 5 million individuals having a biomass of approximately 3,500 metric tons (Wolotira et al., 1977). Blue king crab are found in the more western areas of Norton Basin. Their biomass in 1976 was estimated to be about 1,500 metric tons, with a population estimate of 3.4 million crabs (Wolotira et al., 1977). Another arthropod species, the tanner crab (*Chionoecetes opilio*), was the most abundant crab species in Norton Basin in 1976 demersal surveys, but the individuals were small sized and were nearly all juveniles (Wolotira, 1980). Biomass was estimated to be 1,400 metric tons, with a population size of 52 million crabs (Wolotira et al., 1977). Tanner crabs in Norton Basin appear to be basically the juvenile portion of a crab population which extends out of the Basin (Wolotira, 1980). The Chirikov Basin area, north of St. Lawrence Island, contains high densities of ampeliscid amphipods, which are an important food of bottom-feeding gray whales.

### (3) Fish Resources

The fishes in Norton Basin are derived from both subarctic-boreal and arctic marine communities. The approximately 87 fish species can be divided into three distinct groups: 1) coldwater fishes indigenous to arctic marine waters (e.g., Arctic cod, longhead dab, and Arctic flounder; 2) subarctic boreal fishes whose distribution is centered south of Norton Basin in the Bering Sea or the Pacific Ocean (e.g., salmon, saffron cod, yellowfin sole, starry flounder, Pacific herring); 3) anadromous freshwater fishes (e.g., char, whitefishes, and smelts). The density of fishes and epibenthic invertibrates, especially of demersal populations, is considerably lower than demersal resources in the northeastern Gulf of Alaska or the eastern Bering Sea (Norton Basin: 2.5 MT (metric tons) per square kilometer; eastern Bering Sea: 11.9 MT/sq.km,; northeastern Gulf of Alaska: 7.7 MT/sq.km,; calculated from Wolotira, 1980). Pelagic resources of Norton Basin also appear less abundant than in other Alaskan regions, as suggested by multi-year catch statistics. In Norton Basin, the salmon harvest for several years has averaged about 13% of amounts harvested in the Yukon-Kuskokwim region, 6% of the Bristol Bay (SE Bering Sea) catches, and 2% of catches for both the Gulf of Alaska and southeastern Alaska (Wolotira, 1980). The demersal fisheries of Norton Basin are dominated by cods and flatfishes, which comprised over 75% of the demersal fish biomass estimated in 1976 (Wolotira et al., 1977). Saffron cod and starry flounder are the predominant demersal forms, with saffron cod accounting for nearly one-half of the demersal fish biomass and starry flounder about 10% during 1976 surveys. Several other demersal fish species are relatively abundant, including the shorthorn sculpin, yellowfin sole, and Alaska plaice. Arctic cod was estimated to be the second most numerous fish taxon in Norton Basin, even though it had a relatively low biomass estimate. Pelagic fishes include: five species of Pacific salmon, Pacific herring, rainbow or toothed smelt, capelin, other salmonids (char and whitefish), and other smelts. Pacific herring is the most important marine pelagic species in the Norton Basin (Burns et al., 1982), as it is an important link in the marine foodweb, including humans. Two other relatively important pelagic species are rainbow (toothed) smelt and capelin.

### (4) Marine Mammals

Pacific walruses, ringed, bearded, spotted and ribbon seals are abundant or common seasonally within this planning area while polar bears are common or occur occasionally within different parts of the basin. About 90 percent (225,000) of the Pacific walrus population occurs seasonally within this basin with the advance and retreat of the pack ice front during spring and fall migrations. Major seasonal haulout concentration areas are located on St. Lawrence Island, King Island, the Diomede Islands in the Bering Strait and Sledge and Besboro Islands within Norton Sound. Calving takes place in the basin during spring migration. An estimated 150,000 ringed seals occur within this planning area with primary pupping habitat located on fast ice along the coast of St. Lawrence Island, Norton Sound, and the Yukon River Delta. Up to 75,000 spotted seals are present in the eastern Bering Sea in Alaskan waters with a major portion of this population moving through this basin with the advance and retreat of the pack ice front. About 8,000 to 10,000 spotted seals remain in the planning area during the open water, summer season. About 35,000 ribbon seals and 120,000 bearded seals occur in the eastern Bering Sea with major portions of these populations present in the planning area during ice cover. Floating sea ice within the basin provides primary breeding and pupping habitat for tens of thousands of bearded, spotted, and ribbon seals during spring migration. An estimated 200 to 300 polar bears or 10 percent of the western Arctic population occur seasonally in the Norton Basin primarily north from St. Lawrence Island.

Most common whale species in the Norton Basin planning area are beluga, killer, and minke whales. Small numbers of harbor and Dall porpoises, and more rarely, northern right whale dolphin and certain beaked whale, have also been observed. Most of the 9,000 or more belugas migrating through the northern Bering Sea pass through the planning area and through the Bering Strait in spring (late March-May). Some, however, summer in nearshore shallow waters around Norton Sound, and calving is known to occur in Norton Bay. In December, belugas return through the northern Bering Sea. Some are believed to winter northwest of St. Lawrence Island. Minke and killer whales are frequently observed near St. Lawrence Island from spring through fall.

### (5) Coastal and Marine Birds

An estimated 2.2 million seabirds occupy colonies in and adjacent to the Norton Basin area during the breeding season (May-November). Major colonies or colony concentrations are found on St. Lawrence Island (1.8 million), King Island (246,000), Fairway Rock (47,000) and at Bluff (49,000) east of Nome (Sowls et al., 1978). Just to the north of this area, Little Diomede Island hosts 1.3 million seabirds (presumably Big Diomede Island contains comparable numbers). Norton Sound has a relatively small nesting population. Murres, auklets, puffins and kittiwakes are the most abundant species. Pelagic densities in the vicinity of St. Lawrence Island in summer are at least 343 birds/sq.km. (Eppley and Hunt, 1984). Densities as high as 775 birds/sq.km. are recorded near the northern boundary (Gould et al., 1982). The Yukon-Kuskokwim River Delta, a major North American nesting and staging area for waterfowl and shorebirds lies adjacent to the southern boundary of the lease area Norton Sound (Sale 57) FEIS, 1982. Over 24 million individuals are estimated to use this area during the year. Nesting densities as high as 400 nests/sq.km. have been recorded. Since ice covers most of the area in winter, overwintering seaducks and seabirds are concentrated in the St. Lawrence Island polynya and in the ice front when present. Oldsquaw, murres and other seaducks and seabirds can be abundant in these habitats. Estimates for St. Lawrence range as high as 500,000 oldsquaw and 50,000 eiders (Fay, 1961). Openings in the ice front may contain densities as high as 10,000 murres/sq.km. (Divoky, 1981).

### (6) Endangered and Threatened Species

#### (a) Whales

St. Lawrence Island has been described as the extreme northern limit of the right whale's range. Fin and humpback whales are occasionally seen in this area from late May through September. They feed on euphausiids and small schooling fish. Gray whales arrive in the area from May to June. The Chirikov Basin (between St. Lawrence Island and Bering Strait) is one of several primary summer feeding areas for gray whales. Although gray whales mainly prey on tube-dwelling amphipods they also feed on more pelagic crustaceans. They begin their fall migrations in September but a few remain into December. Bowheads overwinter in the polynyas south of St. Lawrence from December to March. Their spring migration route is mostly on the west side of St. Lawrence and Little Diomede Islands then through the

Bering Strait in March and April. Endangered whales seldom enter Norton Sound however during unusual ice conditions they may enter the Sound.

#### (b) Birds and Plants

The arctic peregrine falcon is the only federally listed bird species likely to occur within the planning area. Peregrines are found in the area from spring to fall (April through September) and nest on coastal bluffs or cliffs associated with a major food source such as a seabird nesting colony. The former marine range of the short-tailed albatross extended as far north as the Bering Strait (DeGange, 1981); however, there have been no sightings of this species in the northernmost portion of the range for many years and therefore consider it is unlikely to occur in the area. Likewise, the Eskimo curlew once occurred on tundra regions adjacent to the planning area; but it has not been seen in the region for decades and is presumed to be absent.

There are no federally listed plant species adjacent to the planning area; however, the plant Artemesia senjavinensis (Arctic sage), found on the Seward Peninsula adjacent to the planning area, is a candidate for federal listing.

### b. Socioeconomic Environment

#### (1) Employment and Demographic Conditions

Refer to Section III.D.1.c.(1). for a general discussion.

In the Nome census division, peak employment for 1978 was 2,446 wage and salary jobs in June, compared to only 1,816 the preceding February, for a peak/low ratio of 1.35 (2,446/1,816). Strongly seasonal industries include gold mining, construction, fishing and fish processing, and tourism. However, the recent increases in wage and salary employment in government and services have tended to make the local economy less seasonal than in earlier years. In addition, a small start has been made in attracting tourist visitors to Nome during the winter months as well as during the summer. The area experiences extremely high living costs, which are approximately 225 percent of average U.S. living costs. In 1979 there were about 6,800 people living in the Nome census area mostly of Eskimo descent (more than 60% in the city of Nome).

#### (2) Coastal Land Uses

In the Norton Sound area most of the land is in federal or Native ownership. The southern part of Norton Sound, from approximately the Yukon delta east to St. Michael, is part of the Yukon Delta National Wildlife Refuge; the northern portion of the Seward Peninsula is part of the Bering Land Bridge National Preserve; and various coastal islands, spires, and rookeries are part of the Bering Sea Unit of the Alaska Maritime National Wildlife Refuge. Native ownership is concentrated along the coast.

Nome, the regional center of Norton Sound, has a hospital, correctional facility, and community college. The hospital and other health care facilities are operating near capacity. Infrastructure in Nome has been upgraded recently: water and sewer services are available in the townsite; water storage is adequate for both offshore drilling and residents; and the airstrip, which is paved, has been repaired. Permit approval and two-thirds of the financing have been received to construct a dock for medium-draft vessels.

### (3) Commercial Fisheries

The Nome-Norton Sound region includes all of Norton Sound and adjacent areas of the Bering Sea extending westward beyond St. Lawrence Island and northward to Little Diomede Island, as well as many rivers and streams which empty into Norton Sound or the Bering Sea. Within this region are the City of Nome, with a 1980 population of approximately 3000 (Institute of Social and Economic Research, 1984), and 17 smaller towns and Social and villages ranging in population from less than 100 persons to over 600 persons. The combined population of the 17 smaller communities was more than 4,200 in 1980 (U.S. Bureau of the Census, 1982). In every one of these smaller commumities, commercial and subsistence fishing together with other subsistence food gathering activities play an important role in the livelihood of virtually every family (Policy Analysts, Limited, June 1980). In addition, wages earned in fish processing provide one of the few sources of cash income for families in the smaller communities. Even in the City of Nome a large number of Alaska Native (Eskimo) families rely upon subsistence fishing to a significant degree, and some Nome families also are active in commercial fishing (Personal Communication, Richard Stern, Director of Subsistence Division, Alaska Department of Fish and Game, June 30, 1984). Alaska Natives make up about 60 percent of the population of Nome, and Natives constitute 90 percent of the population of the other communities in the region.

Damage to the fish of the Nome-Norton Sound region could also affect residents of communities on the Yukon River. The Yukon, which flows into Norton Sound, is the spawning ground for salmon which migrate through Norton Sound twice during their life cycle. More than 8,000 Eskimo and Indian people, in addition to those in the Nome-Norton region discussed above, live in the Yukon Delta area and in commumities upstream from the delta. Nearly all of these Native people are dependent in varying degrees upon commercial and subsistence fishing and on other types of subsistence food gathering (Alaska Department of Fish and Game, 1984a).

The most important commercial fish harvests in the Nome-Norton Sound region are salmon, herring, red king crab, and arctic char. In the Yukon River region the only important commercial harvest is for salmon. In both regions, subsistence harvesting of many species of fish and shellfish occurs (Alaska Department of Fish and Game, 1984a, and 1984b). In the Nome-Norton Sound region and the Yukon River region combined, annual payments to fishermen in the years 1980 - 1983 have ranged from more than $6 million to more than 10 million and wage payments for fish processing and tendering have averaged more than $1.5 million. In the two regions combined a total of at least 14,000 people, most of whom are Alaska Natives

(Eskimos and Indians), rely on commercial fish harvesting and processing, subsistence fishing, and on other subsistence food gathering activities for a large share of their livelihood (ibid.).

### (4) Recreation and Tourism

Certain areas in the Norton Sound region that have recreation and tourism values have been identified by the Alaska Division of Parks and the Joint Federal-State Land Use Planning Commission. The Kigluaik Mountains to the north of Nome are visually and scenically distinctive. The historic community of Nome, in terms of design and character of its buildings is visually significant. The upper drainage of the Unalakleet River is scenic, and the entire coastline of the Norton Soung region has visual and scenic value. Of tourism value are the mine tailings along the foothills of the Kigluaik Mountains, remains from previous settlements and mining operations, trails and routes visible in the tundra and wetland environments, and commerce and subsistence practices of the people living along the shore and inland. Of interest to some visitors is the remnant of the Bering land bridge in a national preserve north of Nome. Scientists find it one of the most likely regions where prehistoric Asian hunters entered the New Continent. The Iditarod Trail, a National Historic Trail designated so by Congress, attracts hundreds of tourists who observed the 1000 mile dogsled race, over the trail from Anchorage to Nome each year.

### (5) Archaeological Resources

Prehistoric sites, historic sites (both on and offshore, and shipwrecks comprise the major archaeological resources of the Norton Sound area. These resources represent the remains of the material culture of past generations of the region's prehistoric and historic inhabitants. They are basic to our understanding of the knowledge, beliefs, art, customs, property systems, and other aspects of the nonmaterial culture. The predominant types of prehistoric resources found on the shores near the Norton Basin planning area are house pits containing the household and subsistence artifacts of early people (stone lamps, sinkers, arrowheads, etc.). Historic artifacts found onshore near the proposed area consist of old houses, roadway inns, fish camps, mining camps, and downed World War II aircraft.

Submerged artifacts, if found, would be similar to those prehistoric resources listed above (burins, stone lamps, arrowheads, etc.); they may have been scattered by tidal currents and geological changes (Hopkins, 1967). It is estimated that less than 1 percent of all rig-implacement surveys would locate these artifacts, since only large anomalies, 1 meter or larger, can be distinguished with side scan sonar. Magnetometers detect only metal objects and these, if found, would likely be from historical objects. It is estimated that less than 2 percent of all surveys for rig emplacements might locate a sunken ship within the boundaries of the proposed areas.

### (6) Transportation

The transportation network of the Norton Basin region is dominated by the City of Nome. Nome, the largest city in western Alaska, has an airfield suitable for use by medium sized jet aircraft and C-130 class cargo planes. Dock facilities at the Nome harbor are to be expanded, in the near future, to accomodate vessels drawing in excess of 6.2 meters draft. Associated with the expanded dock will be an adjacent offshore storage facility which could be used to support oil and gas activities. Other locations which could serve air support bases are, among others, St. Mary's and Unalakleet.

### (7) Subsistence-Use Patterns

The Inupiat and Yupik Eskimos of the Norton Sound lease sale area depend on subsistence fish (80% in Kotlik), marine mammals (22% in Alakanuk), birds, whales, and other foods harvested locally. Their language, culture, spiritual beliefs, customs, and values are all tied into an integrated, holistic view of the world centered around the traditional hunting, fishing, gathering way of life associated with their local resources. All native residents of the area are dependent upon subsistence items.

There are four subsistence patterns within the area: 1) small sea mammal hunting, inland hunting and fishing pattern (Shishmaref, Brevig Mission, Teller, and Mary's Igloo) where residents hunt (in order of preference) bearded, ring and spotted seals, walrus, waterfowl, fish, reindeer (on the Seward Peninsula), and moose; 2) large sea mammal hunting pattern (Wales, Inalik [Little Diomede], King Island, Gambell, and Savoonga [St. Lawrence Island]) which is predominantly oriented towards walrus and bowhead whaling (on St. Lawrence Island), as well as seals, fish, and shellfish; and 3) Norton Sound fishing and coastal and inland hunting pattern (Solomon, Golovin, White Mountain, Council, Elim, Koyuk, Shaktoolik, and Unalakleet) which are primarily oriented towards fishing with salmon as the dominant species, beluga whales, seals, moose (in Nome, Council, Solomon, and White Mountain) and caribou (Shaktoolik, Unalakleet, and Koyuk) (Norton Sound Sale 57 FEIS, USDOI, 1982). For information on Stebbins and other Yukon River Delta communities, see Section III.D.13.c.(7).

### (8) Sociocultural Systems

The Norton Sound lease sale area is predominantly Eskimo. Villages from Unalakleet north are Inupiat Eskimo and those south of Unalakleet are Yupik Eskimo. Within these areas there are a variety of subgroups of Eskimos. All of these Eskimos share similar characteristics: they are family-oriented and have a kinship-based social structure. The family role is the dominant factor in the individual's behavior and the family pattern is extended rather than nuclear. The people are oriented towards subsistence hunting and fishing and many of the family member functions are related to this subsistence lifestyle. The villages in the Norton Sound area generally have a "umealiq" or skinboat captain structure of their marine mammal hunting crews - a structure which is pervasive throughout the organization of their society. In Nome and Unalakleet there has been a higher degree of westernization than in the smaller villages (Norton Sound Sale 57 FEIS, USDOI, 1982).

## 9. Hope Basin Planning Area

### a. Physical Environment

#### (1) Geology

The Hope Basin Planning Area overlies the continental shelf of the southeastern Chukchi Sea. This part of the shelf is relatively flat, and water depths within the planning area range from about 10 to 60 meters. The petroleum geology of the Hope Basin Planning Area can only be generalized because limited seismic information has been published and no wells have been drilled in the basin. Studies conducted to date indicate a thick section of Tertiary and Cretaceous rocks overlying the acoustic basement, and extensive faulting, which may provide possible traps, is present. Rocks from terrestrial outcrops adjacent to the basin suggest that Hope Basin is filled by nonmarine and shallow-water marine sediments.

#### (2) Physical Oceanography

In the Hope Basin the maximum predicted significant wave height equals about 20 meters (65 ft.). The wave calculations, however, ignore water depth and ice cover; observed maximum wave heights are considerably less than 20 meters. Water depths are shallow, ranging from less than 1 meter to up to 60 meters depth. Water circulation is northerly in summer and southeast in winter.

The ice cover lasts about 75 percent of the year and averages 90 to 100 percent coverage during the coldest times. The basin can be counted on to be ice-free only in August through early October.

#### (3) Water Quality

Water quality of the Hope Basin is considered pristine on the basis of limited trace metal and hydrocarbon analyses. Relevant trace metals occur in concentrations one or more orders of magnitude below applicable water quality criteria of the Environmental Protection Agency.

#### (4) Climate

The climate of the Hope Basin is classified as Arctic. Mean air temperature ranges from -21°C in February to +9°C in July, averaging -6.4°C. Scalar mean winds average 12 knots, peaking at 16 knots in November.

#### (5) Air Quality

Existing air quality in the Hope Basin is considered pristine. The EPA has prepared emissions inventory and ambient air quality estimates for areas in Alaska with relative low populations, based on general emission factor relationships with local economic base and demographic data. Using this method of air quality analysis, the EPA considers Nome and Kobuk election districts, which comprise the closest onshore areas to this basin, to be in compliance with Federal ambient air quality standards. It is most likely that the area's air quality is far superior to the national and state standards. However, no air monitoring has been performed in the Hope Basin.

### b. Biological Resources

### (1) Plankton

### (a) Phytoplankton

The seasonal ice cover is the dominant environmental factor determining the types and abundance of marine life in the Hope Basin. As day length increases in the spring, phytoplankton flourish at the ice edge, in ice leads and open waters, and on the undersurface of the ice. Phytoplankton production during the growing season is estimated to be about 150-250 milligrams of carbon per square meter per day (FAO, 1972). High concentrations of phytoplankton are found in the Bering Strait and in the transition zone between coastal and offshore waters, but values in Kotzebue Sound are low. The contribution of the under-ice algae, mainly diatoms, to the productivity in these waters is uncertain but it is thought to be significant (Goering and McRoy, 1974; Horner and Alexander, 1972).

Phytoplankton production in the lead systems begins by late March, as much as two months before it peaks in the open water. Phytoplankton are concentrated in the near-surface waters and deplete the available nutrients in the surface waters fairly quickly, limiting the most productive period to about five weeks of the summer.

### (a) Zooplankton

The total lower productivity of the Chukchi Sea results in lower abundances of zooplankton, benthos and fish compared to the Bering Sea. The zooplankton assemblage over the Chukchi Sea shelf contains fewer species than in the Bering Sea (Cooney, 1977). Some zooplankton are transported in from the Bering Sea, enhancing the productivity of the Chukchi Sea. Biomass and density may range from about 50 to 200 milligrams per square meter (FAO, 1972). A nearshore community dominated by two cladoceran genera, Evadne and Podon, and the copepods Acartia, Pseudocalanus, and Centropages, appears to be continuous along the coast from Bristol Bay to Point Hope. The more open-ocean community, characterized by the presence of the copepods, Calanus plumchrus and Eucalanus bungii, found on the Bering Sea shelf edge, is advected northward and transported through the Bering Strait. It is found offshore in the Chukchi Sea in summer and fall. Abundance of the open shelf assemblage is considerably greater than the neritic assemblage, and often equals the zooplankton densities found in the Bering Sea (English, 1966).

### (2) Benthos

The invertebrate benthos of the offshore region of the Chukchi Sea is substantial, and is an important food source of marine mammals, especially the bearded seal and walrus. The average biomass of epifaunal invertebrates in the southeastern Chukchi Sea averaged 3.31 g/sq.m. (Feder and

Jewett, 1978), approximately the same level of abundance as found in Norton Sound (3.73 g/sq.m.), the northeast Gulf of Alaska (2.6 g/sq.m.) and two bays around Kodiak (4.7 g/sq.m.). One hundred and seventy-one species of marine invertebrates have been recorded in the area. During trawl surveys, echinoderms comprised 59,9% of the invertebrate biomass, mollusks contributed 12.8%, and crustaceans provided 12.5%. Asteroids (sea stars) represented 48% of the epifaunal invertebrate biomass in a Chukchi Sea-Kotzebue sound study area and were by far the most numerous of the echinoderms (Bowden and Moulton, 1981).

The offshore region is dominated by deposit feeders while suspension feeders, scavengers, and predators are more abundant in nearshore waters. Although echinoderms are the dominant benthic fauna, a variety of crustaceans are also common, including amphipods, shrimp, and crabs. Other frequently taken invertebrates include tunicates, mollusks, annelids and coelenterates.

Nearshore areas contain a wider variety of organisms but lesser abundance than offshore. Scouring of the inshore area by ice prevents any significant epibenthic invertebrate population from being established from the beach out to a depth of about 10 meters (Sparks and Pereyra, 1966). Broad (1978) found 191 species of algae and invertebrates in the littoral region of the southeastern Chukchi Sea.

Fish and demersal shellfish of current or potential economic importance accounted for less than 25% of the Chukchi Sea benthic fauna compared to over 90% for the eastern Bering Sea. Of the 20 most abundant invertebrate taxa of possible commercial importance in the southeastern Chukchi Sea and Kotzebue Sound, Neptunea snails (primarily N. heros) and tanner crab predominated in 1976 trawl surveys (Wolotira et al., 1977). However, they are not considered economically exploitable by commercial ventures.

### (3) Fish Resources

The fish resources of the southeastern Chukchi Sea (Hope Basin) are relatively poorly known, but include marine, anadromous and freshwater species. Limited trawl surveys have found a total of 54 marine fish species representing 13 families. Compared to the Bering Sea, this fish fauna is poor in terms of both species diversity and numerical abundance. It is, nevertheless, apparently greater than the fish fauna of the Beaufort Sea. Four fish species contributed to over half of the total fish biomass in the 1976 BLM/OCS trawl surveys (Wolotira et al., 1977) in waters of the southeastern Chukchi Sea: starry flounder (20.5%), Pacific halibut (11.8%), saffron cod (11.4%), and Pacific herring (9.6%). Arctic cod, despite being the most frequent and abundant fish caught, ranked fifth in biomass (7.6%) because of its smaller individual size. Arctic cod was also the dominant marine fish in both number and frequency of occurrence in the 1959 Atomic Energy Commission survey (Alverson and Wilimovsky, 1966). The distribution of many of the marine species appears to be governed by temperature and salinity (see description of Fish Resources, Chukchi Sea). The marine fish populations are important primarily as a food resource for marine mammal and seabird populations of the region. Sixteen anadromous fish species have been reported from the Chukchi Sea region, including 12 salmonids and 2 smelts. All five species of Pacific salmon common along the Alaskan coast are known to spawn in freshwaters of the Chukchi Sea coast. Most abundant are the pink and chum salmon. The runs of salmon in Chukchi Sea tributaries are greatest in rivers entering Kotzebue Sound, especially the Noatak and Kobuk Rivers.

### (4) Marine Mammals

An estimated 150,000 Pacific walruses including nearly all nursing females and males migrate during the spring through this planning area or adjacently to the west to summer feeding grounds in the northern Chukchi Sea and migrate again through the area in the fall. Approximately 450,000 ringed seals are present in the eastern Chukchi Sea-Hope Basin area during the ice season with primary breeding-pupping taking place on fast ice along the coast of Kotzebue Sound and Hope basin. An estimated 30,000 to 38,000 spotted seals and 12,000 bearded seals occur seasonally within the eastern Chukchi-Hope Basin area with breeding and pupping taking place in the planning area during spring migration. Summer haulout concentrations of spotted seals occur in Kotzebue Sound with a major haulout site located at Cape Espenberg. About 3,000 to 5,000 polar bears occur in the Alaskan Arctic with perhaps 2,000 to 3,000 in the eastern Chukchi Sea including Hope basin planning area. Local concentrations of polar bear occur along the coast where and when pack ice drifts close to the shoreline.

The Hope Basin planning area is used by belugas on their migrations between wintering grounds in the Bering Sea and Beaufort Sea summer feeding grounds, and by a portion of the population as a summer residence. Belugas have been observed in nearly all coastal waters of the Chukchi Sea. Migrating belugas follow both nearshore and offshore (to 60-150 km) leads thorugh the Chukchi Sea enroute to the Beaufort Sea or to a northward route along the Chukotsk Peninsula. Ordinarily, the first individuals appear in open leads between Kivalina and Point Hope by mid-April, with individuals continuing to pass through the area through July. A portion of the beluga population summers in inner Kotzebue Sound using coastal waters for feeding, mating, and calving. The southward fall migration through the area generally begins in September, and by December, belugas have left the Chukchi Sea. Overwintering in the southeastern Chukchi Sea probably occurs only in mild ice years when polynas and lead systems provide sufficient open water.

Limited numbers of Minke whales, killer whales, and harbor porpoises also inhabit the Hope Basin planning area in the summer. Their numbers and movements in the area are not well known. Killer whales are often sighted in the Chukchi Sea along the coast or at the edge of the pack ice. Harbor porpoises are present in nearshore areas in low abundance during the summer, primarily in August when the ice is out and waters are warmest.

### (5) Coastal and Marine Birds

An estimated 1.7 million seabirds occupy colonies in and adjacent to the Hope Basin during the breeding season (May through September). Major colonies are found on Little Diomede Island (1.3 million), Puffin Island (29,000; Chamisso unit of Maritime National Wildlife Refuge), and at Cape Thompson (0.4 million; numbers are declining from this value). Murres, auklets, puffins and kittiwakes are the most abundant species at Diomede, murres and kittwakes at Cape Thompson (Sowls et al., 1978). Pelagic densities as high as 775 birds/sq.km. have been recorded near Little Diomede (Gould et al., 1982). Lakes and lagoons along the eastern boundary of this area south of Point Hope provide important nesting, molting, and staging habitat for waterfowl and shorebirds, and saltmarshes are important foraging areas. Eiders, oldsquaw, pintails and phalaropes are the most abundant species. Migration routes of many species cuts offshore across the southern Chukchi Sea between Bering Strait and Point Hope.

### (6) Endangered and Threatened Species

#### (a) Whales

The gray, fin and humpback whales migrate through the Hope Basin planning area on their migrations to and from northern feeding areas in summer (late June-September). Bowhead whales have mostly migrated through the area by April to mid-May; however, a few may still migrate through in June. During the fall migration, bowheads pass through the western portion of the area from the north coast of the Chukotsk Peninsula during October to December.

#### (b) Birds and Plants

The arctic peregrine falcon is the only federally listed bird species likely to occur within the planning area, being found from spring to fall nesting on coastal bluffs or cliffs associated with seabird nesting colonies. The Eskimo curlew is no longer expected to occur adjacent to the planning area (see Section III.D.12.b.(5)).

There are no federally listed plant species adjacent to the planning area; however, the Arctic sage, found on the Seward Peninsula adjacent to the planning area is a candidate for federal listing.

## b. Socioeconomic Environment

### (1) Employment and Demographic Conditions

Refer to Section III.D.1.c.(1) for general information. In 1970 the population was about 4,048 rising to 5,759 in 1980 for an annual growth rate of 1.8%. Kotzebue is the major town in the area. Federal and State governments provide most of the employment opportunities. Commercial fisheries, tourism and the Native Corporation provide other opportunities for employment.

### (2) Coastal Land Uses

Land in this region is owned primarily by the federal government and the village and regional native corporations. Federal lands include the Bering Land Bridge National Preserve, Cape Krusenstern National Monument, Kobuk

Valley National Park, Noatak National Preserve, and Selawik National Wildlife Refuge.

A limited amount of mining has occurred in the region and major mineral development could take place in the upcoming decade. Even if such mining occurs, subsistence would remain the primary use of land outside the villages.

Kotzebue is the regional center for this area, and contains the regional hospital, jail, and government offices. Most residences in Kotzebue are served with public water and sewer. Although no streets are paved, street maintenance is considered excellent.

### (3) Commercial Fisheries

Both the abudance of marine fish and their size drop dramatically north of the Bering Strait. Trawl surveys in 1959 (Pruter and Alverson, 1962) and in 1979 (Wolotira, et al., 1977) indicate that the availability of commercially valuable demersal fish resources in the Chukchi Sea is very poor. It is not believed that there are any demersal fishery resources in this region of interest to commercial harvesters. The existing commercial fishery in this area is targeted almost exclusively on chum salmon although there is a small harvest of other anadromous fish. The fishing effort is centered predominantly in the Kotzebue district. While this commercial fishery is not nearly as productive as those of Bristol Bay or the Yukon River, it does hold an important place in Kotzebue's present economy. Nearly all commercial fishermen in this district are Eskimos from Kotzebue. The chum salmon from Kotzebue Sound average 9 pounds and are in prime condition. The Kotzebue district fetches the highest price paid in Alaska for this species (as much as $.80/lb in 1979). The 1980 harvest was 367,300 chum valued at $1,447,000 (ADF&G, 1980). The fishery is now considered to be fully exploited. Small amounts of shellfish (25,000 lbs.), whitefish, and Arctic char are also harvested in Kotzebue Sound.

### (4) Recreation and Tourism

Recreation and tourism resources are abundant in the Hope Basin area. The remoteness of the area brings only a few visitors per year to the area.

### (5) Archaeological Resources

Archaeological resources are abundant in the Hope Basin area. 200-300 archaeological sites are known. The area around Point Hope is especially rich in archaeological resources.

### (6) Transportation

Air and marine support activities are expected to issue primarily from Kotzebue. Kotzebue has 1,844 meter airstrip with associated warehouse, terminal and hangar facilities, but due to the shallowness of the Kotzebue sound only minimal marine facilities have been constructed.

### (7) Subsistence-Use Patterns

To date, there has not been an Environmental Impact Statement conducted for an oil and gas lease sale in the Hope Basin planning area. Cultural Dynamics, Ltd. (1983) has conducted some research in the area. Within the Hope Basin there are only three coastal communities: Deering, Buckland, and Kivalina. Although these communities are more oriented towards sea mammal hunting, most of the communities in the area (Noorvik, Selawik, Noatak and the 3 coastal communities) hunt hair and bearded seal, beluga whale, and walrus. Kivalina hunts the bowhead whale, although they have only landed four whales since 1977. Other subsistence resources include caribou, migratory birds, eggs, berries and vegetation. Ambler, Shungnak, and Kobuk have a higher dependency on caribou than do the villages closer to the coast, with Ambler harvesting the largest percentage. In the 1972 subsistence harvest Ambler used 12.8 caribou per person. In that same year, Deering used 1 caribou per person while Noatak and Selawik used 4.1 caribou per person.

### (8) Sociocultural Systems

The Eskimos in the Hope Basin region are Inupiat, as are the Eskimos in the Chukchi and Beaufort Sea regions. There are some variations in the traditional culture (for example in kinship terminology) between the areas because some of these Inupiat were originally inland Eskimos. Even so, their basic sociocultural systems are quite similar in that they both have very strong subsistence oriented cultures with kinship as the dominating feature in their social organization. With the exception of Kivalina, there is no bowhead whaling in the Hope Basin area, therefore there is not the same status associated with boat captains as has been noted in the bowhead whaling villages (Cultural Dynamics, Ltd., 1983). For additional information on Inupiat sociocultural systems, see Section III.D.c.14.(8).

## 10. Chukchi Sea Planning Area

### a. Physical Environment

#### (1) Geology

The Chukchi Sea Planning Area overlies the continental shelf of the northwestern Chukchi Sea. This part of the shelf is broad and relatively flat; water depths generally range from about 10 to 50 meters. A thick section of sedimentary rocks that are prospective for oil and gas underlies most of the planning area. These rocks range in age from Devonian or Mississippian to Tertiary and include a number of formations where oil and gas reservoirs or where strong shows of oil or gas have been found on the North Slope of Alaska. The Chukchi Sea Planning Area also contains diverse geologic structures and stratigraphic features that may contain trapped hydrocarbon fluids. Although no wells have been drilled in the planning area, the exploration wells drilled along the coast of the western part of the National Petroleum Reserve in Alaska, which lies adjacent to the east-central part of the planning area, have showed the presence of gas; but the accumulations have been judged either subeconomic or not completely evaluated.

#### (2) Physical Oceanography

In the Chukchi Sea Basin the maximum predicted significant wave height equals about 19.5 meters (69 ft). The wave calculations, however, ignore water depth and ice cover; observed maximum wave heights are considerably less than 19.5 meters. Water depths are shallow, ranging from about 6 meters to about 80 meters depth.

The ice cover lasts all year and averages 90 to 100 percent coverage during the coldest times. The southern portion of the Chukchi Sea Basin is ice-free in summer.

#### (3) Water Quality

Water quality of the Chukchi Sea is considered pristine on the basis of limited trace metal and hydrocarbon analyses. Relevant trace metals occur in concentrations one or more orders of magnitude below applicable water quality criteria of the Environmental Protection Agency.

#### (4) Climate

The climate of the Chukchi Sea is classified as Arctic. Mean air temperature ranges from -26°C in February to +5°C in July, averaging -11°C. Scalar mean winds average 12 knots, peaking at 16 knots in November.

#### (5) Air Quality

Existing air quality in the Chukchi Sea is nearly pristine. Limited air quality measurements at Pt. Barrow indicate that pristine air quality exists in spring through early winter. However, in late winter sulfur aerosols, soot, and other gaseous pollutants are carried by winds to the region from industrial areas in North America and Eurasia. However, the area's air quality overall is still superior to national and state standards.

### b. Biological Resources

#### (1) Plankton

##### (a) Phytoplankton

As in the Hope Basin area, seasonal ice cover has an overriding effect on the seasonal patterning of phytoplankton production, and hence on the availability of food to higher trophic levels. The pattern of phytoplankton production is basically as described for the Hope Basin. Again, the level of total seasonal and annual productivity is low and does not support as large a zooplankton population as in the Bering Sea. The lower total productivity results in lower abundances of plankton, benthos and fish than are found in the Bering Sea.

##### (b) Zooplankton

Although some zooplankton are apparently advected from the Bering Sea northward to the Chukchi Sea, some north/south or east/west differences have been noted (Zenkevitch, 1963; Johnson, 1956). The distribution of several species indicates a flow of water from the Bering Sea and Strait to a latitude of about 76°N. and around Point Barrow into the western Beaufort Sea. Copepods common to both the Chukchi and Beaufort Seas and numerically the most important copepods of the whole area include: *Calanus finmarchicus*, *C. hyperboreus*, *Metridia longa*, *Microcalanus pygmeus*, *Oithona* spp., *Onacia* spp., and *Pseudocalanus minutus*. Another copepod, *Acartia longiremis*, considered part of the middle-shelf and coastal community by Cooney (1981), was found by Johnson (1956) at virtually all sampled stations in the Chukchi Sea, but was basically absent from the Beaufort Sea.

#### (2) Benthos

The benthic infauna of the Chukchi Sea shelf in the Barrow Arch area has received almost no detailed investigation (Stoker, 1981) despite the importance of the area for such benthic-dependent feeders as walrus and bearded seals (Lowry et al., 1980). The work by Stoker (1981) is essentially the only intensive analysis available. Data from stomach sample analyses of benthic-feeding marine mammals probably give a better notion of the abundance of some infaunal species than do results of benthos sampling programs by scientists (Stoker, 1981). Stoker (1981) found 472 species, 292 genera, and 16 phyla of invertebrates distributed throughout the eastern Chukchi and Bering Seas. Samples from the offshore shelf in the Chukchi Sea area contained the greatest index of species diversity (Brillouin) of any stations in the two seas. In all samples from the Chukchi and Bering seas, polychaetous annelids were most frequent, followed closely by bivalve mollusks, then gastropod mollusks and amphipods, in that order. There were two major faunal assemblages in the Chukchi Sea. The dominant species (density/biomass) in these two groups were 1) the polychaete *Maldane sarsi*, the echinoderm *Ophiura sarsi*, the supunculid *Golfingia margaritacea*, and the bivalve *Astarte borealis*, and 2) the bivalves *Macoma calcarea*, *Nucula tenuis*, and *Yoldia hyperborea*, and the amphipod *Pontoporeia femorata*.

The fauna in the Chukchi appeared to be dominated by boreal Pacific forms, though high- arctic forms were frequent in the northern extremes of the area. Diets of walrus and bearded seal (both infaunal feeders) contain higher percentages of burrowing bivalves than Stoker found (Stoker, 1981; Lowry et al., 1980). Stoker (1981) also found that, when a faunal assemblage was found in both the Chukchi and Bering Seas, its standing stock biomass tended to be higher in the Chukchi. But within the Chukchi, the more northerly areas had lower standing stocks. The infaunal system of the Chukchi Sea is apparently dominated by detritus feeders, with a considerable complement of filter feeders (Stoker, 1981). The epifauna of the shelf waters of the Chukchi Sea area has, similarly to the infauna, been scarcely studied. Frost and Lowry (1983) found 238 species or species groups (49 gastropods, 34 amphipods, 28 polychaetes, 27 echinoderms, 25 bivalves, 16 ectoprocts and 14 shrimps) in samples from the north eastern Chukchi and western Beaufort Seas combined. In comparison, Feder and Jewett §91978) found 171 species (11 phyla) in the southeastern Chukchi Sea-Kotzebue Sound area. These results suggest that epibenthic diversity may be higher in the more northerly area. Frost and Lowry (1983) found echinoderms to be by far the most abundant invertebrates in the northern Chukchi and western Beaufort. Of the 27 species of echinoderms, 15 were asteroids, 7 ophiuroids, and 1 each of echinoid, crinoid, and holothuroid. Ophiuroids were the most abundant echinoderm in the Chukchi Sea samples. Broad (1978) found 87 species of algae and invertebrates in the littoras of the north Chukchi Sea compared to 191 species for the south Chukchi and 121 for the Beaufort Sea. Macroalgal beds, although very little studied in the Chukchi Sea, appear more widespread in the Chukchi than in the Beaufort Sea, appear more widespread in the Chukchi than in the Beaufort Sea. The predominant species may be *Laminaria saccharina* and *L. solindungula*.

### (3) Fish Resources

Marine fish resources of the Chukchi Sea have been little studied. From this limited sampling, the number of marine fishes reported for the Chukchi Sea is 41 species, representing 11 families (Morris, 1981). Distribution of marine fish species in the Chukchi Sea appears to be governed by temperature and salinity. Yellowfin sole and saffron cod occupy the shallower, seasonally warmer waters, while Arctic cod and Bering flounder are usually found in deeper, colder waters. Arctic flounder, starry flounder, and fourhorn sculpin frequent low-salinity waters near estuaries and the mouths of rivers. Higher-salinity waters are preferred by most of the other marine fish species that probably occur throughout the broad coastal shelf (Morris, 1981). Generally, marine fish in this region are smaller than those in areas further south, and densities are much lower (Bowden and Moulton, 1981). It has been suggested that many of the marine fish populations are maintained by recruitment of eggs and larvae transported north from the Bering Sea by the Alaska Coastal Current.

Arctic cod was the dominant offshore demersal fish in the north eastern Chukchi Sea during a late summer-early fall trawl survey in 1977 (Frost et al., 1978). Marine fishes that are important prey of marine mammals and seabirds in the Chukchi Sea include Arctic cod, Pacific sand lance capelin, Pacific herring, saffron cod, sculpins, and smelt (Seaman and Burns, 1981; Lowry et al., 1979; Springer and Roseneau, 1979). Thirteen anadromous fish species have been reported from the Chukchi coast and freshwaters (Morrow, 1981). Important anadromous fishes include pink salmon, chum salmon, Arctic char, ciscoes, whitefishes, and smelt. Sockeye, coho, and king salmon are occasionally caught in coastal waters but they generally reach their northern spawning limit in the Point Hope-Point Lay coastal sector at Cape Lisburne.

### (4) Marine Mammals

Nearly the entire nursing female and calf population of Pacific walrus feed during the summer within the northern Chukchi Sea half of which is included in this planning area. An estimated 120,000 bearded seals occur year-round in the eastern Chukchi Sea with several thousand more present during the summer season that migrate from the Bering Sea. The resident breeding ringed seal population of the eastern Chukchi Sea ranges from 300,000 to 450,000 with over a million occurring in the Chukchi Sea during the summer along the pack ice front. The summer population of spotted seals range from 30,000 to 38,000 in the eastern Chukchi Sea with coastal haulout concentrations located at Kasegaluk lagoon, Kuk river mouth, and Peard Bay. About 3,000 to 5,000 polar bears occur in the Alaskan Arctic with perhaps 2,000 to 3,000 present in the eastern Chukchi Sea including this planning area. Coastal concentrations of polar bears sometimes occur at Icy Cape and Point Franklin (Peard Bay) locations along the coast of the planning area when pack ice drift close to shore.

Belugas in the Chukchi Sea are largely transient, passing through as they migrate between the Bering and Beaufort Seas. The North American arctic population is estimated to be at least 30,000 of which an estimated 11,500 migrate through the Chukchi Sea in April or May enroute to the eastern Beaufort Sea. A number of belugas, believed to be of a different stock, summer in Peard Bay feeding and mating in nearshore waters. In the fall, belugas again migrate through the Chukchi Sea on their way to overwintering grounds in the Bering Sea. During September, migrating belugas are believed to feed in nearshore habitats of the eastern Chukchi Sea. Occasionally killer and minke whales have been observed in the planning area.

### (5) Coastal and Marine Birds

Several million birds, including seabirds, waterfowl and shorebirds, occupy areas adjacent to the Chukchi Sea lease area in the Chukchi Sea from April (seabirds) and May (waterfowl) to October. Nearly all of the seabirds, numbering about 157,000 (Sowls et al., 1978), are found at Cape Lisburne (127,000) and Cape Lewis (28,000). Murres, kittiwakes and horned puffins are the most abundant species. Small colonies further north contain pelagic cormorant, glaucous gull, arctic tern, black guillemot and/or common eider. A major portion of the world population of Ross' gull occurs along the pack ice edge in the Chukchi Sea in September-October. In spring (May-June), large numbers of migrant king eiders (about one million), common eider (tens of thousands), oldsquaw (hundereds of thousands) and brant (tens of thousands) move north through the Chukchi area both along the coast and following off-shore leads, as well as overland (brant, etc.) Salt marshes and lagoons are extremely important feeding areas for these and other migrant waterfowl and shorebird populations. Waterfowl nesting populations adjacent to the Chukchi area are modest, but together with substantial numbers of shorebirds, total nesting densities may be 100 to 600/sq.km. (Lehnhausen and Quinlan, 1981). Important molting areas include Peard Bay, Wainwright, Kasegaluk Lagoon, nearshore waters off Point Lay and Ledyard Bay (LGL, 1984). Fall migration of waterfowl follows the coast through this area, while seabirds generally migrate further offshore.

### (6) Endangered and Threatened Species

#### (a) Whales

Humpback and fin whales have not been sighted farther north of the Chukchi Sea, and 70° N latitude is probably their northernmost range. Gray whales are commonly sighted during the summer to fall (July-October) in both the American and Russian portions of the Chukchi Sea. Summer concentrations occur off Wainwright to Pt. Franklin including Peard Bay and west of Cape Lisburne (about 170° E longitude). Feeding areas occur in the Cape Lisburne and Pt. Belcher vicinity. Bowheads migrate in the offshore leads in spring (late March through mid-May) and a small portion of the population migrates nearshore from Barrow to Wainwright in fall (September-October). The majority of the population crosses the northern portion of the planning area in fall while migrating to the north coast of the Chukotsk Peninsula.

#### (b) Birds and Plants

The arctic peregrine falcon is the only federally listed bird species likely to occur within the planning area (see Section III.D.13.b.(5)). In areas lacking coastal bluffs, peregrines nest on cliffs (including high, sandy river banks), and low hills. The Eskimo curlew is no longer expected to occur adjacent to the planning area (see Section III.D.12.b.5.).

There are no federally listed plant species adjacent to the planning area; however, the candidate plant Salix ovalifolia var. glacialis (round leaf willow) may be found on the coast adjacent to the planning area.

## b. Socioeconomic Environment

### (1) Employment and Demographic Conditions

Refer to Section III.D.1.c.(1) for general information. There are about 980 people in 4 villages in the Chukchi planning area. Primary employment opportunities are offered by the military, State and Federal governments and the capital improvement projects of the North Slope Borough.

### (2) Coastal Land Use

Land adjacent to the Chukchi Sea planning area is in the North Slope Borough (NSB). Most land in the NSB is held by a few major land owners. The predominant land owner within the NSB is the federal government. Of the approximately 20 million hectares in the region north of 68°N. latitude, over one-half is contained in the National Petroleum Reserve in Alaska (NPRA) and the Arctic National Wildlife Refuge (ANWR). Portions of the Noatak National Park and Preserve and the Gates of the Arctic National Park and Preserve also are found within the North Slope Borough (Wickersham and Flavin, 1983). Other major landholders include the NSB (36.4 thousand hectares), the State of Alaska (1.4 million hectares), the eight Native village corporations, and the Arctic Slope Regional Corporation (1.8 million hectares including in lieu and surface lands of village corporations). Most of the shoreline bordering or in proximity to the Chukchi Sea Planning Area has been selected by village corporations, the Arctic Slope Regional Corporation (ASRC), or the State. Only two short segments remain federally owned.

Major land uses on the North Slope outside the villages are divided between traditional subsistence uses of the land and hydrocarbon development operations. Land use within the villages has changed rapidly since 1978 as a result of the NSB Capital Improvement Program (CIP). Through the CIP all types of housing have increased rapidly. New housing has been constructed for residents, teachers, and government employees and bunk houses have been built for Prudhoe Bay workers. To service these dwellings, water, sewage disposal, power supplies, and roads have been built also. Fire stations and some air terminals have been constructed, and runways, health service buildings, and public schools have been replaced. As a result, developed areas around villages have expanded tremendously. (NSB 1983a, and Alaska Consultants, Inc. et al., 1984).

Some seasonal recreation activity occurs on the North Slope by visitors from other locations in Alaska as well as outside the state.

### (3) Commercial Fisheries

There are no commercial fisheries in the Chukchi Sea area. Generally, marine fish in this region are smaller than those in areas further south, and densities are much lower (Bowden and Moulton, 1981). Both the average and maximum sizes of flatfish taken during a study of the southeastern Chukchi Sea were below those accepted by U.S. commercial fishery markets (Alverson and Wilimovsky, 1966). The physical climate of the Chukchi Sea may be responsible for limiting population sizes and depressing normal growth patterns of marine fishes (Anderson and Wilimovsky, 1966).

### (4) Recreation and Tourism

Recreation and tourism values in the Chuckchi Sea area are much the same as they are for the (Beaufort Sea area) except that not many visitors enter the area from outside because it is so remote.

### (5) Archaeological Resources

The offshore shelf is important as a potential source of evidence of prehistoric cultures in the Chukchi Sea Area. The geological record of the area (MMS Report, 1983) suggests that water action and ice gouging have left few if any archeological landforms intact. It is therefore improbable that useful archaeological resources of prehistoric times would be found offshore. Offshore shipwrecks are more likely to be found because of the many disasters which occurred in the offshore area of this area. At Point Belcher alone there were 28 ships frozen in the ice in September 1871, and 12 others during September 1876. Seventy-six whaling vessels, an average of more than six per year, were lost in the period from 1865 to 1876 because of ice and raids of the Shenandoah which burned 21 whaling ships near the Bering Strait during the Civil War (Bockstoce, 1977). No one can be certain that ice or water dynamics have destroyed all of these shipwrecks. The possibility exists that some of them still remain and can be found; the probability is highest around Point Belcher, Icy Cape, and Point Hope. Onshore archaeological resources near the Chukchi Sea coast receive less damage from the eroding shoreline than on the Beaufort Sea Coast which is subjected to more slumping because of water action and permafrost. Therefore known onshore archaeological resources exist in greater numbers and unknown ones are also more likely to exist.

### (6) Transportation

The northwest coastline of Alaska has virtually no infrastructure which could be used beyond the exploratory period of offshore oil and gas activities. Small airstrips exist at Pt. Lay, Pt. Hope, and Wainwright. Some relic strips exist at abandoned DEW line sites and there are still others which remain as artifacts of the U.S. Navy oil exploration program in NPRA. All of these would have to be significantly upgraded to allow use by larger aircraft. In regard to marine infrastructure, the nearshore shallowness of the Chukchi is such that only rudimentary docking facilities have been constructed. Supplies transported by ocean-going ships or barges come ashore "over the beach" via shallow draft lighters.

### (7) Subsistence-Use Patterns

For the Inupiat people of the North Slope, the traditional subsistence economy of hunting, fishing, and gathering is increasingly becoming interdependent with the cash or wage economy. However, in a survey done in 1983, over three-fourths of the respondents from the Chukchi region stated they got most or all of their meat from hunting and fishing. This trend has been accelerating with the Prudhoe Bay discovery, the founding of the North Slope Borough and subsequent channeling of funds and employment opportunities to the Inupiat. Point Hope, Point Lay, and Wainwright subsistence harvests are in the lease sale area as well as Atqasuk whose residents travel to the coast to hunt marine mammals. The primary subsistence resources in Point Hope, Wainwright, and Barrow are bowhead whale, caribou, beluga whales, ugruk (bearded seal), seal, walrus, polar bear, freshwater and ocean fish, ducks, geese, and eggs. Bowhead whaling is the single most valued activity in the North Slope subsistence economy today. Atqasuk and Point Lay residents hunt the same species with the exception of the bowhead whale. To a limited extent Atqasuk residents travel to the coast to hunt beluga whales, seals, and walrus (Diapir Field Lease Offering DEIS, USDOI, 1984 and Barrow Arch DEIS unpublished notes).

### (8) Sociocultural Systems

The villages of the North Slope Borough (NSB) have been experiencing considerable change in the past decade with the exploration and development of oil at Prudhoe Bay-Kuparuk and the large NSB Capital Improvement Projects (CIP). Despite modernization, Inupiat society continues be based on a subsistence oriented culture with the bowhead whale hunt as a integral element in that culture. Whaling remains at the center of Inupiat spiritual and emotional life; it embodies the values of sharing, association, leadership, kinship, arctic survival, and hunting prowess. The ramifications of the whale hunt are more than emotional and spiritual. The whaling crew is organized according to social and kin ties within the villages and defines community leadership patterns. Meat sharing (particularly of the bowhead but also of other subsistence foods) helps to integrate the society by joining both giver and receiver to a living tradition and bonding them together. For the North Slope Inupiat there is a close relationship between the spirit of the people, their social organization, and the subsistence hunt (Diapir Field Lease Offering DEIS, USDOI, 1984).

## 11. Beaufort Sea Planning Area

### a. Physical Environment

#### (1) Geology

The Beaufort Sea Planning Area includes the entire Alaskan Beaufort Sea continental shelf, slope and rise, the MacKenzie Cone part of the Canadian Beaufort Sea continental rise, and a small part of the Canada Basin abyssal plain. Water depths within the planning area range from about 2 meters on the shelf to more than 3,800 meters over the abyssal plain. The shelf area can be divided into two sections of contrasting geologic structure and stratigraphy. The western section, which extends from Point Barrow to approximately 145°W. longitude, is characterized by the Barrow Arch and a thick continental terrace consisting of Albian to Tertiary clastic sediments. The eastern sector, from 145° W. longitude to the Canadian border, is dominated by two anticlines and an intervening syncline developed in late Cenozoic sedimentary rocks. The shelf area is underlain by sedimentary rocks with potential for oil and gas deposits. Ten of the thirteen major stratigraphic units of the Ellesmerian and Brookian sequences beneath the coastal Alaskan plain contain commercial pools or strong shows of oil or gas. The shelf rocks also contain a number of structures with the potential for trapping economic accumulations of hydrocarbon. The presence of a thick section of oil- and gas-bearing rocks and the indications of many potential traps suggest the possibility of a high level of hydrocarbon resources in the area.

Six wells have been drilled in the leased blocks in the Beaufort Sea Planning Area; these wells were drilled from four man-made gravel islands. A well drilled from Seal Island, located about 20 kilometers northwest of Prudhoe Bay, indicated a potential hydrocarbon discovery; but the well drilled from Mukluk Island, located in Harrison Bay about 110 kilometers northwest of Prudhoe Bay, did not reveal commercially producible hydrocarbons. A determination was made that hydrocarbons could be produced in paying quantities from the two wells drilled from an unnamed gravel island, located about 6 kilometers northeast of Prudhoe Bay, and from the two wells drilled from Tern Island, located about 32 kilometers east of Prudhoe Bay; these determinations were made in accordance with Alaska OCS Orders Governing Oil and Gas Lease Operations (Order No. 4).

#### (2) Non-Petroleum Mineral Resources

The only known potential non-petroleum mineral resources of the Beaufort Sea Planning Area are sand and gravel; however, based on publicly available information, the sand and gravel resources of the Alaskan Beaufort Sea continental shelf are, for the most part, poorly known when evaluated as a construction material. This is especially true when trying to determine the quantity of specific size classes. The marine accumulations of sand and gravel consist of material derived from relic deposits. Known sand and gravel deposits of the Beaufort Sea Planning Area occur on the shoals lying north of Harrison Bay and seaward of the barrier islands east of Harrison Bay. Studies indicate that these shoals are constructional features that are slowing migrating shoreward.

### (3) Physical Oceanography

In the Beaufort Sea Basin the maximum predicted significant wave height equals about 17 meters (55 ft.). The wave calculations, however, ignore water depth and ice cover; observed maximum wave heights are considerably less than 17 meters. Water depths range from 2 meters to over 3800 meters depth. Ocean currents have mostly low velocities and are from east and west. The ice cover lasts all year and averages 90 to 100 percent coverage during the coldest times. The ice cover is incomplete nearshore in summer.

### (4) Water Quality

Water quality of the Beaufort Sea is considered pristine on the basis of limited trace metal and hydrocarbon analyses. Relevant trace metals occur in concentrations one or more orders of magnitude below applicable water quality criteria of the Environmental Protection Agency.

### (5) Climate

The climate of the Beaufort Sea is classified as Arctic. Mean air temperature ranges from -29°C in February to +3°C in July, averaging -13°C. Scalar mean winds average 11 knots, peaking at 14 knots in November.

### (6) Air Quality

Existing air quality in the Beaufort Sea Basin is nearly pristine. Limited air quality measurements at Pt. Barrow indicate that pristine air quality exists in spring through early winter. However, in late winter sulfur aersols, soot, and other gaseous pollutants are carried by winds to the region from industrial areas in North America and Eurasia. Measurable quantities of pollutants are emitted from the Prudhoe Bay/Kuparuk oil production complex. However, the area's air quality overall is still superior to national and state standards.

## b. Biological Resources

### (1) Plankton

#### (a) Phytoplankton

Phytoplankton blooms generally appear in the upper water column in late spring or early summer as a result of lengthening daylight and ice breakup. The distribution, composition and abundance of phytoplankton are variable and patchy. Abundance of phytoplankton appears to be greatest in nearshore waters with decreasing numbers further offshore. Near the mouths of major rivers, phytoplankton abundance may be limited part of the year due to reduced light caused by heavy sediment load in the water column, while high nutrient loads in other nearshore areas may lead to rich phytoplankton communities. Peak abundance of phytoplankton occurs in late July and early August due to increased light intensity during this period. Annual primary production is considered low: generally less than 20 grams of carbon per square meter per year (Carey et al., 1978) compared to the Bering Sea estimate of 121 gC/sq.m./yr (McRoy and Goering, 1974). Ice algae, estimated to contribute from 6 percent (Horner et al., 1974) to about 25-30 percent of the total annual production of the area (Alexander, 1974), assume importance as the major source of primary production in the early spring.

(b) Zooplankton

Over 100 species of zooplankton have been identified for the Beaufort and Northeastern Chukchi Seas. Copepods make up the dominant group both in terms of number of species and total biomass. The greatest abundance of grazers occurs coincidentally with peak phytoplankton abundance in spring and summer.

(2) Benthos

The benthic communities of the Beaufort Sea are comprised of benthic microalgae, macrophytic algae, and benthic invertebrates. The standing stock of macrophytic algae is considered very sparse throughout the Alaskan Beaufort Sea. A fairly large kelp community known as the Boulder Patch occurs in Stefansson Sound. Cobbles and boulders exist in this area in sufficient densities to provide a firm substrate for attachment of a large stand of both red and brown kelp, and a diverse assortment of epifaunal invertebrates. The overall contribution of benthic microalgae to the primary production in the Beaufort Sea remains unknown. Benthic invertebrates can be divided into infauna and epifauna. Infauna found within the Beaufort Sea region include oligochaetes, polychaetes, bivalve mollusks, echiuroids, and chironomid (midge) larvae. Sessile benthic epifauna are uncommon in the Beaufort Sea and are usually found attached to hard substrate such as rocks, cobble, or wood, and even to kelp fronds. Sessile epifauna include barnacles, hydroids, anemones, bryozoans and mussels. Mobile benthic epifauna are dominated by the crustaceans (amphipods, misids, isopods, cumaceans, euphausiids, and decapods), although echinoderms and gastropods are also prominent. Mobile epifauna form a substantial portion of the diets of the vertebrate consumers (fish, birds, and marine mammals). In nearshore waters, principally at depths to 2 meters, benthic infauna are characterized as poor in species and biomass, unevenly distributed, and largely depopulated annually by shore-fast ice. There are, however, resident populations of oligochaetes and chironomid larvae. Beyond 2 meters, infaunal diversity and biomass increase, and species composition changes. The principal species are polychaetes, gammaridean amphipods, an isopod, bivalve mollusks, and a priapulid worm. Mobile epifaunal invertebrates invade these nearshore waters annually during the open-water season; amphipods and mysids appear to be the dominant epifaunal types found in these nearshore migrations. Biomass and diversity generally increase with depth in the inshore or intermediate zone, except in the shear zone (15-25 meters in depth) where intensive ice-gouging occurs. Diversity and biomass of infauna increase beyond this minimum abundance zone with distance offshore, at least as far as the continental shelf (200 meters).

### (3) Fish Resources

The fish that occupy portions of the Beaufort Sea at least during some portion of their life cycles include: 1) occasional freshwater visitors, 2) anadromous species, and 3) marine species. There have been 43 marine and anadromous fish species reported for the Beaufort Sea, compared to 47 for the Northeastern Chukchi, and over 300 species for the Bering Sea and Gulf of Alaska. This low species number has been attributed to low temperatures, low productivity, and harsh ice conditions which preclude extensive use of shoreline habitats during the winter period. Anadromous species found in the nearshore waters of the Beaufort Sea include arctic char, arctic cisco, least cisco, Bering cisco, boreal smelt, humpback whitefish, and broad whitefish. Pink and chum salmon have been reported from Simpson Lagoon (Craig and Haldorson, 1981) and along the western Beaufort (Schmidt et al., 1983); however, their occurrence is thought to be occasional with relatively low abundance. Distribution of anadromus species along the coastline is highly variable in both numbers and species composition, although most species appear to use the nearshore brackish water habitats as feeding and rearing areas during the open-water season. Much less is known concerning marine fishes. In general, marine species are widely distributed throughout the Beaufort Sea in relatively low densities, with schooling species such as arctic cod displaying a rather patchy distribution. Some marine species, arctic cod and capelin, sporadically enter the nearshore areas to feed on the abundant epibenthic fauna or to spawn; while others, like fourhorn sculpin and flounder, remain in coastal waters throughout the ice-free period, moving further offshore with the development of the shorefast ice during the winter. The most important marine species in terms of abundance include the arctic cod, fourhorn sculpin, saffron cod, capelin, and several species of snailfish, arctic flounder, and starry flounder. The arctic cod has been described as a "key species of the Arctic Ocean" because of its abundance, widespread distribution, and importance to the diets of marine mammals, birds and other fish.

### (4) Marine Mammals

The total population of ringed seals in the Beaufort Sea planning area range from about 300,000 to 600,000 with the coastal breeding population at about 40,000. The bearded seal population is estimated at about 45,000 with highest densities occurring along the ice flow zone between the 20 and 100 meter isobath. An estimated 12,000 Pacific walruses occur during the summer season along the pack ice front north of Barrow and northeast of Dease Inlet within the planning area. The summer population of spotted seals range from 1,000 to 3,000 with coastal concentrations occurring on the Colville River Delta, Dease Inlet and Piasuk River mouth in Smith Bay. Of the total Alaskan Arctic population of polar bears, probably 2,000 occur in this planning area with an average density of one bear per 30 to 50 square miles with higher densities present seasonally along the ice flow zone between the 20 meter and 100 meter isobaths.

The planning area is traversed by approximately 6,000 belugas migrating between the Canadian Beaufort Sea and the Bering Sea. Eastbound belugas cross the Beaufort Sea from May to June, following the 30-100 kilometer offshore lead system northeast to Banks Island, and then south to the MacKenzie Delta where a major portion of the Beaufort Sea population concentrates for feeding during July and August. Belugas may pass Point Barrow as early as late March or as late as July. The timing of the fall migration is not well known, but belugas depart the Canadian Beaufort in August and September, and pass through the western Beaufort Sea in September or October. Small numbers of belugas have been observed migrating along the coastline while larger numbers have been documented in open water or near the edge of the pack ice. Barrow appears to be the northern limit of the minke whale's range. On occasion, the belugas may enter the Beaufort Sea but they prefer to stay in the eastern portions of the Canadian Beaufort Sea.

### (5) Coastal and Marine Birds

Coastal bird colonies adjacent to the Beaufort Sea lease area consist of small aggregations of a few species on barrier islands, most frequently common eider, glaucous gull, arctic tern and/or black guillemot (Sowls et al., 1978; Norton and Sackinger, 1981). The largest breeding bird concentration (waterfowl and shorebirds) occur on moist tundra and marsh of the arctic slope. Highest densities occur in nearshore areas (less than 20m depth) such as Peard Bay, Plover Islands, Pitt Point-Cape Halkett, Colville River Delta, Simpson Lagoon, Beaufort Lagoon and Demarcation Bay. These areas support 50 to 100 birds/sq.km. with flocks of thousands of birds/sq.km. occurring where food is abundant. In addition, high average densities (38.1 birds/sq.km.) occur in a productive area off Point Barrow (Divoky, 1983; Diapir Field, Sale 87, FEIS, 1984). Beginning in mid-July, large concentrations of 10,000 or more molting oldsquaw occur in several (Peard Bay, Simpson and Beaufort Lagoons, Thetis Island), and large numbers of phalaropes and other shorebirds feed intensively in coastal beach, lagoon and barrier island habitats. Use of lagoons and other coastal habitats peaks in August just before and during fall migration. Tens of thousands of birds, primarily molting and staging waterfowl and shorebirds, may use these and coastal tundra habitats on most major river deltas, Teshepuk Lake and the Arctic National Wildlife Refuge.

### (6) Endangered and Threatened Species

#### (a) Whales

The gray whale is the only other endangered whale which has been sighted in the Beaufort Sea. They are most likely to occur in July and August. The Beaufort Sea planning area encompasses the primary migrating route of the bowhead whale during spring and fall. The spring migration changes from a near shore location (along leads adjacent to shore ice) to a band along approximately 71°30' N latitude after passing Pt. Barrow. Most bowheads have migrated past Pt. Barrow by mid May. The summer feeding area is in the Canadian Beaufort Sea where mostly copapods are eaten and a few benthic amphipods are taken. A late summer/early fall (August-September) feeding and staging area occurs well offshore (ice permitting) between Barter Island and the Canadian border from late August to early September. Bowheads follow the 20-50 m isobath during the fall migration generally leaving the planning area by the end of October. Current population estimates, based on spring ice camp estimates, are approximately 4,000 individuals.

#### (b) Birds and Plants

The arctic peregrine falcon is the only federally listed bird species likely to occur within the planning area (see Section III.D.14.b.5.).

There are no federally listed plant species adjacent to the planning area; however, the candidate plant species round leaf willow and *Thlaspi arcticum* may be found in coastal regions adjacent to the planning area.

### c. Socioeconomic Environment

#### (1) Employment and Demographic Conditions

Refer to Section III.D.1.c.(1) for general information. There were about 2,724 people in the 4 traditional villages of this planning area. Barrow is by far (2,207) the largest. In addition there are over 6,000 workers residing in oil field enclave camps in the north slope. The oil industry is by far the largest employer in the area. The North Slope Borough capital improvement projects, State and Federal governments also offer employment opportunities.

#### (2) Coastal Land Uses

The North Slope Borough (NSB) borders the Beaufort Sea Planning Area. Ownership and land use patterns of the NSB were discussed in Section III.D.11.c. Two enclaves for oil and gas development are located along the Beaufort coast. The primary center is Deadhorse located in proximity to the Prudhoe Bay oil and gas field. The other center is in the Kuparuk oil field.

#### (3) Commercial Fisheries

The only continuous commercial fishing operation on Alaska's North Slope is operated by a single family (Helmericks) during the summer and fall months in the Colville River Delta. Anadromous fishes, particulary cisroes and whitefish, are the focus of the fishery. Of the four species taken, arctic cisco is the most important cash product. This species, along with broad and humpback whitefish, is sold for human consumption in Fairbanks and Barrow. Least cisco are also taken in large numbers, and are sold for dog food. Average annual catch statistic (1964-1981) for these species are as follows:

| Species | Number | Percent | Total Weight (lbs.) |
|---|---|---|---|
| Arctic Cisco | 32,548 | 57 | 32,548 |
| Least Cisco | 20,863 | 36 | 12,518 |
| Broad Whitefish | 2,030 | 4 | 10,353 |
| Humpback Whitefish | 1,677 | 3 | 8,552 |

It is estimated that about 9 percent of the arctic ciscoes and 5 percent of the least ciscoes are exploited by commercial fisheries every year.

### (4) Recreation and Tourism

Remote and outdoor recreation resources in the Beaufort Sea region may be divided into offshore resources and onshore resources, and any changes in offshore resources will impact onshore and vice versa. The somewhat pristine character of the National Petroleum Reserve (NPRA) is an attractive feature of the area on shore of the Diapir Field lease area. Few people actually go deeply into the NPRA areas. Most of the present recreation-oriented activity onshore is in the form of organized tour groups. About 5,000 people come to Barrow yearly and make excursions into remote areas. The offshore environment of the area is seasonally variable. Viewed from offshore and onshore the summer landscape has a character defined by landform, vegetation, water, and color. There are thousands of miles of shoreline along the Diapir Field. Flat, elongated offshore islands and spits formed by longshore currents add to the visual variety along Elson Lagoon, Dease Inlet, Peard Bay and Kasegaluk Lagoon. In the winter, a feature peculiar to this region is that it is nearly impossible to tell where onshore and offshore begin and end. This unity of shore and offshore lasting for long periods of winter is a particularly unique feature of this area related to recreation and tourism.

### (5) Archaeological Resources

Much of the potential for the occurrence of archaeological resources in the Beaufort Sea area is reduced in water depths which can be reworked by ice gouging, thaw-freeze action, and water dynamics (MMS Summary Report, Outer Continental Shelf Cultural Resources Meeting, Sept. 14, 1982). The report concludes that no areas were found that have the potential for prehistoric sites, contain landforms significant for human habitation, or have enough Holocene sediment for site preservation occurred a few miles north and east of Barrow and 33 have occurred a few miles north and west of Point Belcher between 1868 and 1914. No surveys for locations of these have been made and none have been accidently or deliberately discovered; therefore, no exact locations are known. These would be valuable finds providing us information on past cultural norms and practices particularly with regard to the whaling industry.

### (6) Transportation

The arctic plain which borders the BeaufortSea is dotted with active and inactive airstrips. A number of fields are relics from the U.S. government oil exploration programs of the '40's, '50's, '70's, and 80's, while others

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mark the site of abandoned DEW line stations. At present, scheduled jet service and high volume cargo operations are handled through Wiley Post Will Rogers Memorial Airfield at Barrow and the Deadhorse airfield at Prudhoe Bay. Both fields have airstrips of approximately 2,030 meters and associated warehouses and terminal structures. Current use of these facilities is much less than their operational capacity. The balance of the active airstrips are for the most part Federal facilities which are regularly used by military, scientific, and industrial aircraft. Public use is on an emergency basis.

Marine transportation in along the arctic coast is hindered by extreme shallowness of the nearshore waters. Ships must anchor one to two miles of shore and lighten their freight. These conditions are fairly uniform across the arctic coast. Marine support for offshore operations will be limited to the three open water months and supplemented by air cushion vehicles and ice roads emanating from strategically placed support bases.

### (7) Subsistence-Use Patterns

The subsistence-use patterns in the Beaufort Sea area are quite similar to those of the Chukchi Sea area (see Section III.D.11.c.(7). Bowhead whaling is important in all coastal villages: Barrow, Nuiqsut, and Kaktovik. Whaling has the same significance in these villages as described for the Chukchi Sea villages. In addition to the bowhead whale, other subsistence resources are caribou, freshwater and ocean fish, ducks and geese. Barrow residents also hunt ugruk (bearded seal) and beluga whales. Nuiqsut residents hunt moose and Kaktovik residents hunt Dall sheep (Diapir Field Lease Offering DEIS, USDOI, 1984).

### (8) Sociocultural Systems

There are few differences between the sociocultural systems of the Chukchi Sea and Beaufort Sea villages of the North Slope Inupiat (these two lease sale areas encompass the entire North Slope Borough with the exception of the inland village of Anaktuvuk Pass). For information on the North Slope Inupiat sociocultural systems, see Section III.D.14.c.(8).

# IV. ENVIRONMENTAL CONSEQUENCES

## A. Basic Assumptions and Significant Impact Producing Agents Evaluated in the Impact Analysis

### 1. Resource Estimates and Development Timetables

In March 1985, the regional geologic assessments of resource potential were completed and, using PRESTO (Probabilistic Resource Estimates - Offshore) estimates of conditional undiscovered, economically recoverable resources and their associated marginal probabilities were derived for each planning area for use in the 5-year program analyses. These PRESTO evaluations were based on economic conditions and projections as of the beginning of 1984. They were also based on identified geologic prospects and, due to gaps in the data in certain planning areas or limitations in the analysis of the data, the PRESTO evaluations were supplemented with hypothetical or postulated prospects which were created from empirical geologic data in analog areas and extrapolations of known trends.

Percentages of the PRESTO mean resource estimates were subsequently allocated to each sale in the proposal and alternatives and to intervening sales to be held prior to the beginning of the 5-year program (1/1/87). The total leased and unleased PRESTO resource estimates per planning area were used in predicting sale-by-sale percentages of resources. The leased lands and intervening sales were also allocated percentages of the total resources. This method was followed assuming that the marginal probability for each sale in a planning area will remain constant.

Numerous uncertainties exist in specific estimation of resource percentages for each sale where the amount and location of most promising, (focused) Outer Continental Shelf (OCS) acreage to be offered in a particular sale are unknown. It is advisable, therefore, to make general assumptions on percentages of resources to be leased in each sale. The sale-by-sale percentages of resources were based on past leasing rates, industry interest, prospect distribution, infrastructure justification, leasable resources, and sale type.

The leasing rates were developed using either PRESTO resource estimates leased in past sales or estimated risked resources calculated from the total high bids received in a sale and the number of tracts leased. The prospect distributions were extracted from the PRESTO computer runs. The prospects were ranked in descending order based on resource potential, and the first sales (including intervening sales) were assumed to lease prospects with the highest resource potential. Later sales were allocated prospects with lower resource potential. Using this approach, it was assumed that the best prospects would be leased first. These prospect resource estimates are conditional on the fact that hydrocarbons exist within the planning area, but they are not conditional on hydrocarbons existing in each prospect.

The percentages of resources were further constrained by maximum leasable resources per planning area which were estimated for use in the 5-year Secretarial Issue Document (SID) analysis. The total resources allocated to all sales within a planning area should not exceed the SID leasable resource estimates. However, it was also assumed that every sale in the proposal of the 5-year program will be held and will justify its own infrastructure. Thus, in certain low-potential Alaskan planning areas and in the Beaufort Sea where the leasable resources did not justify the expectation of a platform per sale, the total percentage of resources allocated to sales in the planning areas were allowed to exceed the percentage of leasable resource quoted in the SID. In the Shumagin Planning Area, the resource potential was marginal to the point that sales had to share a platform.

The estimation of resource percentages also attempted to account for the effects resulting from the sale types assumed in the different alternative schedules. It was assumed that if the sales in a planning area were to be altered from triennial to biennial sales, the amount of exploratory information available between sales would be reduced and the percentage of resources to be leased in the reoffering sales would also be reduced. This reduction was assumed to be directly proportional to the reduction in exploration and delineation wells projected to be drilled between sales. This method affected only one future biennial sale in the Southern California Planning Area.

Based on the sale-by-sale resource percentages, conditional undiscovered, economically recoverable resource estimates to be leased and infrastructure estimates to be developed were derived, aggregated, and reported on a planning area basis. These estimates are conditioned by the assumption that commercial quantities of hydrocarbons will be found and, as such should not appear without associated marginal probabilities of commercial hydrocarbons. These conditional estimates are representative of a situation which has a probability of occurrence equal to the probability of commercial hydrocarbons. If aggregation of the reported planning area estimates is made for comparative purposes, it is necessary to apply the risk factors to the individual planning area estimates prior to aggregating. The result will be risked resource and infrastructure estimates. In summing resources in this manner, it is assumed that the planning areas are geologically independent. The conditional resource estimates for each planning area and for each sale within the planning area have been risked by their associated marginal probabilities for purposes of economic evaluation in the 5-year SID analysis. However, in this environmental impact (EIS), conditional estimates are used as the basis for assessment of potential environmental impact.

The infrastructure (development timetable) was estimated using general rules-of-thumb concerning hydrocarbon recoveries for the life of wells, platform sizes, and exploration and development scenarios. The estimates of well recoveries and platform sizes were based on regional assumptions, tract evaluations from previous sales, and inputs to the last 5-year program analysis. An attempt was made to use similar assumptions in the frontier areas of the Pacific and Atlantic Regions. In the frontier areas (including Eastern Gulf of Mexico), the well recoveries used were on a barrel-of-oil-equivalent (BOE) basis assuming that energy equivalent BOE's are appropriate for infrastructure estimation. In the developed areas of the Gulf of Mexico and southern California, separate well recoveries for oil and gas were assumed for the life of the wells. In the Arctic, only well recoveries for oil were assumed because the gas is estimated to be uneconomic, based on current cost/price relationships and foreseeable technological advances. The resource potential in the Arctic was assessed out to the 200-foot water depth which is considered to be the limit of current and foreseeable technology. The magnitude of the assumed fields was sufficient to justify transportation facilities and shore bases. The exploratory, delineation, and development well estimates and the platform estimates associated with these rules-of-thumb were scheduled to be completed in the future using reasonable drilling rates and development scenarios which were based on historical yearly constraints on platform installations, development well drilling, and number of rigs.

The following basic assumptions were followed in the development of resource estimates and infrastructure information:

1. Following the completion of the regional geologic assessments (7/84), no information will result in changing the geologic interpretations (and the resource estimates). Geologic, engineering, and economic interpretations and analyses are frozen as of July 1984.

2. All of the conditional resources allocated to each sale will be leased, discovered, developed, and commercially produced.

3. For the High Case scenario in the 5-year EIS, after adjusting for resources leased in intervening sales in each planning area, the remaining unleased resources will all be leased during the proposed 5-year schedule and will contribute to the infrastructure.

4. In the Cumulative Impact Case of the 5-year EIS, the total leased and unleased resource potential and the total developed and undeveloped reserve estimates as of July 1984 will contribute to its infrastructure.

5. Resource allocation to be leased in supplemental sales will be an integral part of, and will be included in the sales in which these resources were originally discovered.

Table IV.A.1-1 presents the resource estimates and development timetable for the proposed action. Exploration and development assumptions for the proposal and the impact analysis of the proposal are based on these estimates.

Table IV.A.1-2 presents the resource estimates and development timetable used in the evaluation of cumulative impacts of the proposal. The cumulative case resource estimates include estimates of total leased and unleased resource potential and the total of developed and undeveloped reserves. Table IV.A.1-3 presents the resource estimates and developmet timetable used in the assessement of potential impacts of a high case senario. This scenario assumes the development of all remaining unleased resources in planning areas as a result of this 5-year program.

Tables IV.A.1-4, IV.A.1-5, and IV.A.1-6 present the resource estimates and development timetable for Alternative III - Add a Sale in the Straits of Florida, Alternative IV - Biennial Leasing, and Alternative V - Acceleration Provision, respectively. Resource estimates for Alternative VI which proposes deferral of leasing in six whole planning areas are assumed to remain the same for the remaining planning areas.

Resources estimates for the subareas deferred in Alternative I - the Proposal, and the subareas being considered for deferral under Alternative II have not yet been developed. Resource estimates for these subareas will be developed prior to the preparation of the final EIS and the decision on the Proposed Final Program. Therefore, the impact analyses in this draft EIS for subarea deferrals in Alternative I and Alternative II are done on a qualitative basis.

## Table IV.A.1-1
## Conditional oil and gas resources and infrastructure for Alternative I - The Proposed Action

| Planning Area | No. Sales | Conditional Resources Oil (Million bbls) | Conditional Resources Gas (BCF) | Million BOE | Marginal Probability of Commercial Hydrocarbons | No. Exploratory and Delineation Wells | No. Development/ Production Wells | No. Platforms | Exploratory and Delineation Wells First Year | Exploratory and Delineation Wells Last Year | Exploratory and Delineation Wells Period of most intense activity | Platforms First Year | Platforms Last Year | Platforms Period of most intense activity | Development/ Production Wells First Year | Development/ Production Wells Last Year | Development/ Production Wells Period of most intense activity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N. Atlantic | 2 | 49 | 961 | 220 | 0.30 | 18 | 26 | 2 | 1990 | 1994 | 1992 | 1997 | 1997 | 1997 | 1998 | 2000 | 1998 |
| Mid-Atlantic | 1 | 25 | 419 | 100 | 1.00 | 9 | 11 | 1 | 1991 | 1993 | 1991-93 | 1996 | 1996 | 1996 | 1997 | 1998 | 1997 |
| S. Atlantic | 1 | 69 | 1294 | 299 | 0.25 | 11 | 35 | 1 | 1991 | 1993 | 1992-93 | 1996 | 1996 | 1996 | 1997 | 1999 | 1997-98 |
| W. GOM | 5 | 437 | 6155 | 1532 | 1.00 | 713 | 912 | 76 | 1988 | 2000 | 1992-96 | 1992 | 2005 | 1995-98 | 1992 | 2006 | 1996-98 |
| C. GOM | 5 | 1004 | 8286 | 2479 | 1.00 | 1246 | 1596 | 133 | 1988 | 2001 | 1992-97 | 1992 | 2005 | 1996-99 | 1992 | 2006 | 1997-99 |
| E. GOM | 2 | 62 | 329 | 120 | 1.00 | 19 | 36 | 2 | 1990 | 1995 | 1990-94 | 1995 | 1998 | 1995-98 | 1996 | 2001 | 1996-2000 |
| Wash./Oregon | 1 | 58 | 1043 | 243 | 0.20 | 10 | 29 | 1 | 1993 | 1995 | 1995 | 1998 | 1998 | 1998 | 1999 | 2001 | 1999-2000 |
| N. Calif. | 2 | 231 | 1023 | 413 | 0.60 | 20 | 48 | 2 | 1990 | 1994 | 1992 | 1997 | 1997 | 1997 | 1998 | 2001 | 1998-99 |
| C. Calif. | 1 | 207 | 292 | 259 | 0.65 | 11 | 30 | 1 | 1991 | 1993 | 1992-93 | 1996 | 1996 | 1996 | 1997 | 1999 | 1997-98 |
| S. Calif. | 2 | 462 | 726 | 591 | 1.00 | 207 | 475 | 10 | 1988 | 1995 | 1991-93 | 1992 | 1997 | 1994-96 | 1992 | 1999 | 1996 |
| Gulf of Alaska | 1 | 113 | 1751 | 425 | 0.08 | 12 | 42 | 1 | 1990 | 1994 | 1990-91 | 1998 | 1998 | 1998 | 1998 | 2002 | 1998-2001 |
| Kodiak | 1 | 95 | 1840 | 422 | 0.05 | 12 | 42 | 1 | 1993 | 1998 | 1993 | 2001 | 2001 | 2001 | 2002 | 2007 | 2002-06 |
| Cook Inlet | 1 | 179 | 298 | 231 | 0.03 | 10 | 23 | 1 | 1993 | 1997 | 1993 | 2000 | 2000 | 2000 | 2001 | 2003 | 2001-02 |
| Shumagin | 2 | 48 | 1363 | 291 | 0.03 | 9 | 30 | 1 | 1992 | 1996 | 1992-93 | 1999 | 1999 | 1999 | 2000 | 2003 | 2000-02 |
| N. Aleutian | 1 | 173 | 1258 | 397 | 0.20 | 12 | 39 | 1 | 1991 | 1996 | 1991-92 | 2000 | 2000 | 2000 | 2001 | 2005 | 2001-04 |
| St. George | 1 | 135 | 1261 | 360 | 0.22 | 11 | 35 | 1 | 1991 | 1994 | 1991-93 | 1998 | 1998 | 1998 | 1999 | 2003 | 1999-2002 |
| Navarin | 2 | 1920 | 2336 | 2336 | 0.27 | 82 | 229 | 7 | 1989 | 1994 | 1991-93 | 1998 | 2002 | 1999-2000 | 1998 | 2006 | 2001 |
| Norton | 1 | 102 | 470 | 186 | 0.15 | 10 | 18 | 1 | 1991 | 1994 | 1991-93 | 1998 | 1998 | 1998 | 1999 | 2003 | 1999-2002 |
| Hope | 1 | 145 | 1539 | 418 | 0.02 | 13 | 40 | 1 | 1993 | 1997 | 1993-96 | 2001 | 2001 | 2001 | 2002 | 2006 | 2002-06 |
| Chukchi Sea | 2 | 1152 |  | 1152 | 0.20 | 37 | 105 | 3 | 1989 | 1995 | 1991-92 | 1997 | 1999 | 1997-99 | 1998 | 2004 | 2000-01 |
| Beaufort Sea | 2 | 627 |  | 627 | 0.70 | 22 | 61 | 2 | 1989 | 1994 | 1991 | 1998 | 1998 | 1998 | 1999 | 2002 | 1999-2001 |
|  | 37** | 3596* | 19,057* | 6987* |  |  |  |  |  |  |  |  |  |  |  |  |  |

* These are totals of risked resource estimates and not the sum of conditional estimates in the columns above. See discussion in Section IV.A.1 regarding aggregation of resource estimates.

**The proposal also includes five annual supplemental sales. See section II.A.1.a. for a description of the proposal.

Table IV.A.1-2

Conditional oil and gas resources and infrastructure for the Cumulative Impact Case

| Planning Area | No. Sales | Conditional Resources and Reserves | | | Marginal Probability of Commercial Hydrocarbons | No. Exploratory and Delineation Wells | No. Development/ Production Wells | No. Platforms | Exploratory and Delineation Wells | | | Platforms | | | Development/ Production Wells | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Oil (Million bbls) | Gas (BCF) | Million BOE | | | | | First Year | Last Year | Period of most intense activity | First Year | Last Year | Period of most intense activity | First Year | Last Year | Period of most intense activity |
| N. Atlantic | 2 | 260 | 5060 | 1160 | 0.30 | 103 | 138 | 11 | 1990 | 1995 | 1992-94 | 1993 | 1999 | 1995-98 | 1993 | 2000 | 1996-98 |
| Mid-Atlantic | 1 | 360 | 5980 | 1424 | 1.00 | 131 | 168 | 14 | 1991 | 2004 | 1990-2003 | 1994 | 2007 | 1994-2007 | 1994 | 2008 | 1995-2007 |
| S. Atlantic | 1 | 860 | 16180 | 3739 | 0.25 | 227 | 440 | 22 | 1991 | 2002 | 1991-2001 | 1994 | 2004 | 1994-2004 | 1994 | 2005 | 1995-2004 |
| W. GOM | 5 | 2127* | 34717* | 8305* | 1.00 | 3082 | 5340 | 615 | 1988 | 2006 | 1992-2002 | 1987 | 2009 | 1995-2006 | 1987 | 2010 | 1996-2006 |
| C. GOM | 5 | 7082* | 66293* | 18878* | 1.00 | 4622 | 18272 | 3584 | 1988 | 2012 | 1992-2007 | 1987 | 2016 | 1995-98 | 1987 | 2017 | 1996-98 |
| E. GOM | 2 | 410 | 2190 | 800 | 1.00 | 131 | 247 | 13 | 1990 | 1998 | 1993-96 | 1993 | 2001 | 1996-99 | 1993 | 2003 | 1998-99 |
| Wash./Oregon | 1 | 180 | 3260 | 760 | 0.20 | 33 | 90 | 3 | 1993 | 1996 | 1993-95 | 1997 | 1999 | 1997-99 | 1997 | 2001 | 1999 |
| N. California | 2 | 420 | 1860 | 751 | 0.60 | 33 | 88 | 3 | 1990 | 1994 | 1992 | 1996 | 1998 | 1996-98 | 1996 | 2000 | 1998 |
| C. California | 1 | 560 | 790 | 701 | 0.65 | 33 | 84 | 3 | 1991 | 1994 | 1991-93 | 1995 | 1997 | 1995-97 | 1995 | 1999 | 1997 |
| S. California | 2 | 2973* | 4717* | 5784* | 1.00 | 688 | 2520 | 56 | 1988 | 2008 | 1991-2003 | 1987 | 2009 | 1994-2005 | 1987 | 2011 | 1996-2005 |
| Gulf of Alaska | 1 | 540 | 8340 | 2024 | 0.08 | 63 | 200 | 5 | 1990 | 1995 | 1990 | 1996 | 2000 | 1996-2000 | 1996 | 2004 | 2000 |
| Kodiak | 1 | 150 | 2920 | 670 | 0.05 | 24 | 66 | 2 | 1993 | 1998 | 1993-98 | 2001 | 2002 | 2001-02 | 2001 | 2006 | 2002-04 |
| Cook Inlet | 1 | 210 | 350 | 272 | 0.03 | 11 | 25 | 1 | 1993 | 1997 | 1993 | 2000 | 2000 | 2000 | 2001 | 2004 | 2001-03 |
| Shumagin | 2 | 50 | 1420 | 303 | 0.03 | 9 | 30 | 1 | 1992 | 1996 | 1992-93 | 1999 | 1999 | 1999 | 2000 | 2003 | 2000-02 |
| N. Aleutian | 1 | 360 | 2620 | 826 | 0.20 | 26 | 80 | 2 | 1991 | 1996 | 1991-92 | 2000 | 2001 | 2000-01 | 2000 | 2005 | 2001-04 |
| St. George | 1 | 1690 | 15760 | 4494 | 0.22 | 147 | 444 | 12 | 1990 | 2002 | 1990-2001 | 1994 | 2005 | 1994-2005 | 1994 | 2009 | 1998-2005 |
| Navarin | 2 | 4800 | 5840 | 5839 | 0.27 | 179 | 569 | 14 | 1989 | 2000 | 1991-93 | 1994 | 2004 | 1995-97 | 1994 | 2008 | 1998-99 |
| Norton | 1 | 640 | 2940 | 1163 | 0.15 | 45 | 112 | 4 | 1991 | 1998 | 1991-97 | 1998 | 2001 | 1998-2001 | 1998 | 2004 | 2001 |
| Hope | 1 | 170 | 1810 | 492 | 0.02 | 13 | 49 | 1 | 1993 | 1997 | 1993-96 | 2001 | 2001 | 2001 | 2002 | 2008 | 2002-07 |
| Chukchi Sea | 2 | 2680 | | 2680 | 0.20 | 85 | 263 | 7 | 1989 | 1995 | 1991-93 | 1996 | 2000 | 1998-99 | 1996 | 2005 | 2000 |
| Beaufort Sea | 2 | 1280 | | 1280 | 0.70 | 38 | 126 | 3 | 1989 | 1994 | 1991 | 1998 | 1999 | 1999 | 1998 | 2003 | 1999-2002 |
| | 37 | 17,227* | 128,653* | 40,119* | | | | | | | | | | | | | |

*Includes developed and undeveloped reserves.

**These are totals of risked resource estimates and not the sum of conditional estimates in the columns above. See discussionin Section IV.A.1 regarding aggregation of resource estimates.

Table IV.A.1-3
Conditional oil and gas resources and infrastructure for the High Case Scenario

| | | Conditional Resources | | | | | | | Exploratory and Delineation Wells | | | Platforms | | | Development/ Production Wells | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Planning Area | No. Sales | Oil (Million bbls) | Gas (BCF) | Million BOE | Marginal Probability of Commercial Hydrocarbons | No. Exploratory and Delineation Wells | No. Development/ Production Wells | No. Platforms | First Year | Last Year | Period of most intense activity | First Year | Last Year | Period of most intense activity | First Year | Last Year | Period of most intense activity |
| N. Atlantic | 2 | 260 | 5060 | 1160 | 0.30 | 103 | 138 | 11 | 1990 | 1996 | 1992-94 | 1993 | 1999 | 1995-98 | 1993 | 2000 | 1996-98 |
| Mid-Atlantic | 1 | 200 | 3350 | 796 | 1.00 | 67 | 91 | 7 | 1991 | 1997 | 1991-96 | 1994 | 2000 | 1994-2000 | 1994 | 2002 | 1996-2000 |
| S. Atlantic | 1 | 820 | 15450 | 3569 | 0.25 | 217 | 420 | 21 | 1991 | 2001 | 1991-2000 | 1994 | 2004 | 1994-2003 | 1994 | 2005 | 1995-2003 |
| W. GOM | 5 | 1320 | 18620 | 4633 | 1.00 | 2143 | 2736 | 228 | 1988 | 2004 | 1992-98 | 1992 | 2006 | 1995-2001 | 1992 | 2007 | 1996-2001 |
| C. GOM | 5 | 2110 | 17280 | 5185 | 1.00 | 2603 | 3324 | 277 | 1988 | 2007 | 1992-98 | 1992 | 2009 | 1995-2001 | 1992 | 2010 | 1996-2001 |
| E. GOM | 2 | 300 | 1580 | 581 | 1.00 | 108 | 181 | 11 | 1990 | 1997 | 1993-94 | 1993 | 2000 | 1996-98 | 1993 | 2002 | 1998 |
| Wash./Oregon | 1 | 180 | 3260 | 760 | 0.20 | 33 | 90 | 3 | 1993 | 1996 | 1993-95 | 1997 | 1999 | 1997-99 | 1997 | 2001 | 1999 |
| N. Calif. | 2 | 420 | 1860 | 751 | 0.60 | 33 | 88 | 3 | 1990 | 1994 | 1992 | 1996 | 1998 | 1996-98 | 1996 | 2000 | 1998 |
| C. Calif. | 1 | 560 | 790 | 701 | 0.65 | 33 | 84 | 3 | 1991 | 1994 | 1991-93 | 1995 | 1997 | 1995-97 | 1995 | 1999 | 1997 |
| S. Calif. | 2 | 1260 | 1930 | 1603 | 1.00 | 557 | 1275 | 27 | 1988 | 2004 | 1991-2001 | 1991 | 2006 | 1994-2003 | 1991 | 2008 | 1996-2003 |
| Gulf of Alaska | 1 | 490 | 8000 | 1913 | 0.08 | 61 | 185 | 5 | 1990 | 1994 | 1990 | 1996 | 2000 | 1996-2000 | 1996 | 2004 | 2000 |
| Kodiak | 1 | 150 | 2920 | 670 | 0.05 | 24 | 66 | 2 | 1993 | 1998 | 1993-98 | 2001 | 2002 | 2001-02 | 2001 | 2006 | 2002-04 |
| Cook Inlet | 1 | 180 | 320 | 237 | 0.03 | 10 | 23 | 1 | 1993 | 1997 | 1993 | 2000 | 2000 | 2000 | 2001 | 2003 | 2001-02 |
| Shumagin | 2 | 50 | 1420 | 303 | 0.03 | 9 | 30 | 1 | 1992 | 1996 | 1992-93 | 1999 | 1999 | 1999 | 2000 | 2003 | 2000-02 |
| N. Aleutian | 1 | 190 | 1360 | 432 | 0.20 | 12 | 42 | 1 | 1991 | 1996 | 1991-92 | 2000 | 2000 | 2000 | 2001 | 2006 | 2001-05 |
| St. George | 1 | 640 | 5990 | 1706 | 0.22 | 65 | 168 | 6 | 1991 | 1996 | 1991-95 | 1995 | 2000 | 1995-2000 | 1995 | 2003 | 1998-2000 |
| Navarin | 2 | 3280 | 4260 | 4038 | 0.27 | 134 | 394 | 11 | 1989 | 1997 | 1991-92 | 1994 | 2001 | 1995-97 | 1994 | 2005 | 1998 |
| Norton | 1 | 130 | 590 | 235 | 0.15 | 10 | 23 | 1 | 1991 | 1994 | 1991-93 | 1998 | 1998 | 1998 | 1999 | 2004 | 1999-2003 |
| Hope | 1 | 170 | 1810 | 492 | 0.02 | 13 | 49 | 1 | 1993 | 1997 | 1993-96 | 2001 | 2001 | 2001 | 2002 | 2008 | 2002-07 |
| Chukchi Sea | 2 | 2680 | | 2680 | 0.20 | 85 | 263 | 7 | 1989 | 1995 | 1991-93 | 1996 | 2000 | 1998-99 | 1996 | 2005 | 2000 |
| Beaufort Sea | 2 | 650 | | 650 | 0.70 | 22 | 63 | 2 | 1989 | 1994 | 1991 | 1998 | 1999 | 1998-99 | 1998 | 2002 | 1999-2001 |
| | 37 | 8,235* | 54,125* | 17,866* | | | | | | | | | | | | | |

*These are totals of risked resource estimates and not the sum of conditional estimates in the columns above.
See discussion in Chapter IV.A.1 regarding aggregation of resource estimates.

Table IV.A.1-4
Conditional oil and gas resources and infrastructure for Alternative III-Add a Sale in the Straits of Florida

| | | Conditional Resources | | | | | | | Exploratory and Delineation Wells | | | Platforms | | | Development/ Production Wells | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Planning Area | No. Sales | Oil (Million bbls) | Gas (BCF) | Million BOE | Marginal Probability of Commercial Hydrocarbons | No. Exploratory and Delineation Wells | No. Development/ Production Wells | No. Platforms | First Year | Last Year | Period of most intense activity | First Year | Last Year | Period of most intense activity | First Year | Last Year | Period of most intense activity |
| N. Atlantic | 2 | 49 | 961 | 220 | 0.30 | 18 | 26 | 2 | 1990 | 1994 | 1992 | 1997 | 1997 | 1997 | 1998 | 2000 | 1998 |
| Mid-Atlantic | 1 | 25 | 419 | 100 | 1.00 | 9 | 11 | 1 | 1991 | 1993 | 1991-93 | 1996 | 1996 | 1996 | 1997 | 1998 | 1997 |
| S. Atlantic | 1 | 69 | 1294 | 299 | 0.25 | 11 | 35 | 1 | 1991 | 1993 | 1992-93 | 1996 | 1996 | 1996 | 1997 | 1999 | 1997-98 |
| W. GOM | 5 | 437 | 6155 | 1532 | 1.00 | 713 | 912 | 76 | 1988 | 2000 | 1992-96 | 1992 | 2005 | 1995-98 | 1992 | 2006 | 1996-98 |
| C. GOM | 5 | 1004 | 8286 | 2479 | 1.00 | 1246 | 1596 | 133 | 1988 | 2001 | 1992-97 | 1992 | 2005 | 1996-99 | 1992 | 2006 | 1997-99 |
| E. GOM | 2 | 62 | 329 | 120 | 1.00 | 19 | 36 | 2 | 1990 | 1995 | 1990-94 | 1995 | 1998 | 1995-98 | 1996 | 2001 | 1996-2000 |
| Wash./Oregon | 1 | 58 | 1043 | 243 | 0.20 | 10 | 29 | 1 | 1993 | 1995 | 1995 | 1998 | 1998 | 1998 | 1999 | 2001 | 1999-2000 |
| N. Calif. | 2 | 231 | 1023 | 413 | 0.60 | 20 | 48 | 2 | 1990 | 1994 | 1992 | 1997 | 1997 | 1997 | 1998 | 2001 | 1998-99 |
| C. Calif. | 1 | 207 | 292 | 259 | 0.65 | 11 | 30 | 1 | 1991 | 1993 | 1992-93 | 1996 | 1996 | 1996 | 1997 | 1999 | 1997-98 |
| S. Calif. | 2 | 462 | 726 | 591 | 1.00 | 207 | 475 | 10 | 1988 | 1995 | 1991-93 | 1992 | 1997 | 1994-96 | 1992 | 1999 | 1996 |
| Gulf of Alaska | 1 | 113 | 1751 | 425 | 0.08 | 12 | 42 | 1 | 1990 | 1994 | 1990-91 | 1998 | 1998 | 1998 | 1998 | 2002 | 1998-2001 |
| Kodiak | 1 | 95 | 1840 | 422 | 0.05 | 12 | 42 | 1 | 1993 | 1998 | 1993 | 2001 | 2001 | 2001 | 2002 | 2007 | 2002-06 |
| Cook Inlet | 1 | 179 | 298 | 231 | 0.03 | 10 | 23 | 1 | 1993 | 1997 | 1993 | 2000 | 2000 | 2000 | 2001 | 2003 | 2001-02 |
| Shumagin | 2 | 48 | 1363 | 291 | 0.03 | 9 | 30 | 1 | 1992 | 1996 | 1992-93 | 1999 | 1999 | 1999 | 2000 | 2003 | 2000-02 |
| N. Aleutian | 1 | 173 | 1258 | 397 | 0.20 | 12 | 39 | 1 | 1991 | 1996 | 1991-92 | 2000 | 2000 | 2000 | 2001 | 2005 | 2001-04 |
| St. George | 1 | 135 | 1261 | 360 | 0.22 | 11 | 35 | 1 | 1991 | 1994 | 1991-93 | 1998 | 1998 | 1998 | 1999 | 2003 | 1999-2002 |
| Navarin | 2 | 1920 | 2336 | 2336 | 0.27 | 82 | 229 | 7 | 1989 | 1994 | 1991-93 | 1998 | 2002 | 1999-2000 | 1998 | 2006 | 2001 |
| Norton | 1 | 102 | 470 | 186 | 0.15 | 10 | 18 | 1 | 1991 | 1994 | 1991-93 | 1998 | 1998 | 1998 | 1999 | 2003 | 1999-2002 |
| Hope | 1 | 145 | 1539 | 418 | 0.02 | 13 | 40 | 1 | 1993 | 1997 | 1993-96 | 2001 | 2001 | 2001 | 2002 | 2006 | 2002-06 |
| Chukchi Sea | 2 | 1152 | | 1152 | 0.20 | 37 | 105 | 3 | 1989 | 1995 | 1991-92 | 1997 | 1999 | 1997-99 | 1998 | 2004 | 2000-01 |
| Beaufort Sea | 2 | 627 | | 627 | 0.70 | 22 | 61 | 2 | 1989 | 1994 | 1991 | 1998 | 1998 | 1998 | 1999 | 2002 | 1999-2001 |
| Florida Straits | 1 | 21 | 551 | 119 | 0.11 | 9 | 13 | 1 | 1993 | 1995 | 1994 | 2000 | 2000 | 2000 | 2000 | 2002 | 2000-01 |
| | 38 | 3,599* | 19,117* | 7,000* | | | | | | | | | | | | | |

*These are totals of risked resource estimates and not the sum of conditional estimates in the columns above.
See discussion in Section IV.A.1 regarding aggregation of resource estimates.

## Table IV.A.1-5
## Conditional oil and gas resources and infrastructure for Alternative 4
(Biennial Sales in Areas of Triennial Leasing in Proposed Program)

| Planning Area | No. Sales | Conditional Resources Oil (Million bbls) | Conditional Resources Gas (BCF) | Million BOE | Marginal Probability of Commercial Hydrocarbons | No. Exploratory and Delineation Wells | No. Development/ Production Wells | No. Platforms | Exploratory and Delineation Wells First Year | Exploratory and Delineation Wells Last Year | Exploratory and Delineation Wells Period of most intense activity | Platforms First Year | Platforms Last Year | Platforms Period of most intense activity | Development/ Production Wells First Year | Development/ Production Wells Last Year | Development/ Production Wells Period of most intense activity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N. Atlantic | 2 | 49 | 961 | 220 | 0.30 | 18 | 26 | 2 | 1990 | 1993 | 1991 | 1996 | 1997 | 1996-97 | 1997 | 2000 | 1998 |
| Mid-Atlantic | 2 | 47 | 777 | 185 | 1.00 | 17 | 21 | 2 | 1990 | 1993 | 1991-92 | 1995 | 1996 | 1995-96 | 1996 | 1998 | 1997 |
| S. Atlantic | 2 | 138 | 2589 | 598 | 0.25 | 22 | 70 | 2 | 1990 | 1993 | 1992 | 1995 | 1996 | 1995-96 | 1996 | 1999 | 1997 |
| W. GOM | 5 | 437 | 6155 | 1532 | 1.00 | 713 | 912 | 76 | 1988 | 2000 | 1992-96 | 1992 | 2005 | 1995-98 | 1992 | 2006 | 1996-98 |
| C. GOM | 5 | 1004 | 8286 | 2479 | 1.00 | 1246 | 1596 | 133 | 1988 | 2001 | 1992-97 | 1992 | 2005 | 1996-99 | 1992 | 2006 | 1997-99 |
| E. GOM | 3 | 86 | 460 | 168 | 1.00 | 28 | 51 | 3 | 1989 | 1995 | 1991 | 1994 | 1998 | 1994,96,98 | 1995 | 2001 | 1997 |
| Wash./Oregon | 1 | 58 | 1043 | 243 | 0.20 | 10 | 29 | 1 | 1993 | 1995 | 1995 | 1998 | 1998 | 1998 | 1999 | 2001 | 1999-2000 |
| N. Calif. | 2 | 231 | 1023 | 413 | 0.60 | 20 | 48 | 2 | 1990 | 1993 | 1991 | 1996 | 1997 | 1996-97 | 1997 | 2000 | 1998-99 |
| C. Calif. | 2 | 297 | 419 | 371 | 0.65 | 20 | 43 | 2 | 1990 | 1993 | 1991-92 | 1995 | 1996 | 1995-96 | 1996 | 1999 | 1997 |
| S. Calif. | 3 | 524 | 823 | 670 | 1.00 | 231 | 525 | 11 | 1988 | 1994 | 1992 | 1992 | 1997 | 1995 | 1992 | 1999 | 1995-96 |
| Gulf of Alaska | 1 | 113 | 1751 | 425 | 0.08 | 12 | 42 | 1 | 1990 | 1994 | 1990-91 | 1998 | 1998 | 1998 | 1998 | 2002 | 1998-2001 |
| Kodiak | 1 | 95 | 1840 | 422 | 0.05 | 12 | 42 | 1 | 1993 | 1998 | 1993 | 2001 | 2001 | 2001 | 2002 | 2007 | 2002-06 |
| Cook Inlet | 1 | 179 | 293 | 231 | 0.03 | 10 | 23 | 1 | 1993 | 1997 | 1993 | 2000 | 2000 | 2000 | 2001 | 2003 | 2001-02 |
| Shumagin | 2 | 48 | 1363 | 291 | 0.03 | 9 | 30 | 1 | 1992 | 1996 | 1992-93 | 1999 | 1999 | 1999 | 2000 | 2003 | 2000-02 |
| N. Aleutian | 2 | 180 | 1310 | 413 | 0.20 | 12 | 41 | 1 | 1990 | 1995 | 1990-91 | 1999 | 1999 | 1999 | 2000 | 2005 | 2000-04 |
| St. George | 2 | 270 | 2522 | 719 | 0.22 | 22 | 70 | 2 | 1990 | 1994 | 1991-92 | 1997 | 1998 | 1997-98 | 1998 | 2003 | 1999-2001 |
| Navarin | 3 | 2208 | 2686 | 2686 | 0.27 | 93 | 263 | 8 | 1989 | 1995 | 1992 | 1998 | 2002 | 1998-2000 | 1998 | 2006 | 2001 |
| Norton | 2 | 122 | 559 | 221 | 0.15 | 10 | 21 | 1 | 1990 | 1993 | 1990-92 | 1997 | 1997 | 1997 | 1998 | 2000 | 1996-99 |
| Hope | 1 | 145 | 1539 | 418 | 0.02 | 13 | 40 | 1 | 1993 | 1997 | 1993-96 | 2001 | 2001 | 2001 | 2002 | 2006 | 2002-06 |
| Chukchi Sea | 3 | 1501 |  | 1501 | 0.20 | 48 | 147 | 4 | 1989 | 1995 | 1992 | 1997 | 1999 | 1998 | 1998 | 2005 | 2000-01 |
| Beaufort | 3 | 666 |  | 666 | 0.70 | 22 | 65 | 2 | 1989 | 1993 | 1990-91 | 1997 | 1998 | 1997-98 | 1998 | 2002 | 1999-2001 |
|  | 48 | 3,989* | 20,445* | 7,626* |  |  |  |  |  |  |  |  |  |  |  |  |  |

*These are totals of risked resource estimates and not the sum of conditional estimates in the columns above. See discussion in Section IV.A.1 regarding aggregation of resource estimates.

### Table IV.A.1-6
### Conditional oil and gas resources and infrastructure for Alternative 5
### Acceleration Provision

|  |  | Conditional Resources |  |  |  |  |  |  | Exploratory and Delineation Wells |  |  | Platforms |  |  | Development/ Production Wells |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Planning Area | No. Sales | Oil (Million bbls) | Gas (BCF) | Million BOE | Marginal Probability of Commercial Hydrocarbons | No. Exploratory and Delineation Wells | No. Development/ Production Wells | No. Platforms | First Year | Last Year | Period of most intense activity | First Year | Last Year | Period of most intense activity | First Year | Last Year | Period of most intense activity |
| N. Atlantic | 2 | 49 | 961 | 220 | 0.30 | 18 | 26 | 2 | 1990 | 1993 | 1991 | 1996 | 1997 | 1996-97 | 1997 | 2000 | 1998 |
| Mid-Atlantic | 1 | 25 | 419 | 100 | 1.00 | 9 | 11 | 1 | 1990 | 1992 | 1990-92 | 1995 | 1995 | 1995 | 1996 | 1997 | 1996 |
| S. Atlantic | 1 | 69 | 1294 | 299 | 0.25 | 11 | 35 | 1 | 1990 | 1992 | 1991-92 | 1995 | 1995 | 1995 | 1996 | 1998 | 1996-7 |
| W. GOM | 5 | 437 | 6155 | 1532 | 1.00 | 713 | 912 | 76 | 1988 | 2000 | 1992-96 | 1992 | 2005 | 1995-98 | 1992 | 2006 | 1996-98 |
| C. GOM | 5 | 1004 | 8286 | 2479 | 1.00 | 1246 | 1596 | 133 | 1988 | 2001 | 1992-97 | 1992 | 2005 | 1996-99 | 1992 | 2006 | 1997-99 |
| E. GOM | 2 | 62 | 329 | 120 | 1.00 | 19 | 36 | 2 | 1989 | 1992 | 1991 | 1994 | 1996 | 1994,96 | 1995 | 1999 | 1997 |
| Wash./Oregon | 1 | 58 | 1043 | 243 | 0.20 | 10 | 29 | 1 | 1993 | 1995 | 1995 | 1998 | 1998 | 1998 | 1999 | 2001 | 1999-2000 |
| N. Calif. | 2 | 231 | 1023 | 413 | 0.60 | 20 | 48 | 2 | 1990 | 1993 | 1991 | 1996 | 1997 | 1996-97 | 1997 | 2000 | 1998-99 |
| C. Calif. | 1 | 207 | 292 | 259 | 0.65 | 11 | 30 | 1 | 1990 | 1992 | 1991-92 | 1995 | 1995 | 1995 | 1996 | 1998 | 1996-97 |
| S. Calif. | 2 | 400 | 629 | 512 | 1.00 | 176 | 400 | 10 | 1988 | 1994 | 1990-91 | 1992 | 1997 | 1993-94 | 1992 | 1999 | 1994 |
| Gulf of Alaska | 1 | 113 | 1751 | 425 | 0.08 | 12 | 42 | 1 | 1990 | 1994 | 1990-91 | 1998 | 1998 | 1998 | 1998 | 2002 | 1998-2001 |
| Kodiak | 1 | 95 | 1840 | 422 | 0.05 | 12 | 42 | 1 | 1993 | 1998 | 1993 | 2001 | 2001 | 2001 | 2002 | 2007 | 2002-06 |
| Cook Inlet | 1 | 179 | 293 | 231 | 0.03 | 10 | 23 | 1 | 1993 | 1997 | 1993 | 2000 | 2000 | 2000 | 2001 | 2003 | 2001-02 |
| Shumagin | 2 | 48 | 1363 | 291 | 0.03 | 9 | 30 | 1 | 1992 | 1996 | 1992-93 | 1999 | 1999 | 1999 | 2000 | 2003 | 2000-02 |
| N. Aleutian | 1 | 173 | 1258 | 397 | 0.20 | 12 | 39 | 1 | 1990 | 1995 | 1990-91 | 1999 | 1999 | 1999 | 2000 | 2004 | 2000-03 |
| St. George | 1 | 135 | 1261 | 369 | 0.22 | 11 | 35 | 1 | 1990 | 1993 | 1990-92 | 1997 | 1997 | 1997 | 1998 | 2002 | 1998-2001 |
| Navarin | 2 | 1920 | 2336 | 2336 | 0.27 | 82 | 229 | 7 | 1989 | 1993 | 1990-92 | 1998 | 2002 | 1998-1999 | 1998 | 2006 | 2001 |
| Norton | 1 | 102 | 470 | 186 | 0.15 | 10 | 18 | 1 | 1990 | 1993 | 1990-92 | 1997 | 1997 | 1997 | 1998 | 2000 | 1998-99 |
| Hope | 1 | 145 | 1539 | 418 | 0.02 | 13 | 40 | 1 | 1993 | 1997 | 1993-96 | 2001 | 2001 | 2001 | 2002 | 2006 | 2002-06 |
| Chukchi Sea | 2 | 1152 |  | 1152 | 0.20 | 37 | 105 | 3 | 1989 | 1994 | 1990-92 | 1997 | 1998 | 1998 | 1998 | 2003 | 1991-2001 |
| Beaufort | 2 | 627 |  | 627 | 0.70 | 22 | 61 | 2 | 1989 | 1993 | 1990-91 | 1997 | 1998 | 1997-98 | 1998 | 2002 | 1999-2000 |
|  | 37 | 3,534* | 18,960* | 6,908* |  |  |  |  |  |  |  |  |  |  |  |  |  |

*These are totals of risked resource estimates and not the sum of conditional estimates in the columns above. See discussion in Section IV.A.1 regarding aggregation of resource estimates.

## 2. Exploration and Development Assumptions

### a. Exploration and Development Assumptions for the Proposed Action

OCS exploration and production involves a variety of facilities such as drilling platforms, support bases, pipelines, gas processing plants, and oil refineries. The nature of exploratory components is largely dependent upon the location of blocks to be drilled, while production components are dependent upon the type, magnitude, and location of economically recoverable reserves which might be discovered. Detailed information on these development components, therefore, cannot be known at the leasing program stage. Nonetheless, these generally foreseeable developments do have the potential for impacting coastal and ocean resources. In order to assess the impacts of such developments, this EIS incorporates exploration and development assumptions about the activities and facilities which could potentially result from the 5-year leasing program.

The exploration and development assumptions for each OCS planning area are contained on the following pages for the proposed action. The identified locations of these possible OCS-related facilities are hypothetical. They do not constitute proposals, nor do they represent commitments to particular locations or even types of facilities. Rather, they are reasonable judgments of what may occur, based on the best information currently available and the resource estimates for the respective planning areas. These assumptions are included in the EIS for analytical purposes only. The impact analysis contained in Section IV.B is built upon these assumptions.

## Exploration and Development Assumptions
## North Atlantic Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploratory and Delineation | 18 |
| Wells, Development and Production | 26 |
| Platforms | 2 |
| Pipelines to Shore - oil | 0 |
| - gas | 1 |

Gathering pipelines included for single point mooring system.

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | 1 | | |
| Heliports | * | | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | * | | |
| Pipe Storage and Coating Yards | ** | | |
| Platform Fabrication Yards | ** | | |
| Pipeline Landfalls | | | 1 |

*Existing facilities are adequate
**Existing facilities outside the Region

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 601,500 bbl. |
| Cuttings | 133,800 bbl. |
| Formation Waters | 39.2 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 1,900 |
| New Population | 4,900 |

## Exploration and Development Assumptions
## Mid-Atlantic Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 9 |
| Wells, Development and Production | 11 |
| Platforms | 1 |
| Pipelines to Shore - oil | 0 |
| - gas | 1 |

Gathering pipelines included for single point mooring system.

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | 1 | | |
| Heliports | * | | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | * | | |
| Pipe Storage and Coating Yards | ** | | |
| Platform Fabrication Yards | ** | | |
| Pipeline Landfalls | | | 1 |

*Existing facilities are adequate
**Existing facilities outside the Region

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 327,900 bbl. |
| Cuttings | 88,280 bbl. |
| Formation Waters | 20 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 1,000 |
| New Population | 2,600 |

# Exploration and Development Assumptions
## South Atlantic Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 11 |
| Wells, Development and Production | 35 |
| Platforms | 1 |
| Pipelines to Shore - oil | 0 |
| - gas | 1 |

Gathering pipelines included for single point mooring system.

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | | 1 |
| Heliports | * | | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | * | | |
| Pipe Storage and Coating Yards | ** | | |
| Platform Fabrication Yards | ** | | |
| Pipeline Landfalls | | | 1 |

*Existing facilities are adequate
**Existing facilities outside the Region

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 666,000 bbl. |
| Cuttings | 206,600 bbl. |
| Formation Waters | 55.2 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 2,100 |
| New Population | 5,400 |

## Exploration and Development Assumptions
## Western Gulf of Mexico Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 713 |
| Wells, Development and Production | 912 |
| Platforms | 76 |
| Pipelines to Shore - oil | 80 |
| - gas | 300 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | 34 | 3 | 3 |
| Heliports | 10 | 2 | 2 |
| Refineries | 3 | 0 | 0 |
| Gas Plants | 14 | 0 | 2 |
| Marine Terminals | 2 | 0 | 0 |
| Pipe Storage and Coating Yards | 6 | 1 | 0 |
| Platform Fabrication Yards | 10 | 2 | 1 |
| Pipeline Landfalls | 10 | 0 | 5 |

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 7,393,750 bbl. |
| Cuttings | 207,345 bbl. |
| Formation Waters | 4.37-393.3 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 12,000 |
| New Population | none |

## Exploration and Development Assumptions
## Central Gulf of Mexico Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 1,246 |
| Wells, Development and Production | 1,596 |
| Platforms | 133 |
| Pipelines to Shore - oil | 100 |
| - gas | 250 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | 25 | 2 | 5 |
| Heliports | 10 | 0 | 3 |
| Refineries | 12 | 0 | 0 |
| Gas Plants | 18 | 0 | 2 |
| Marine Terminals | 9 | 0 | 0 |
| Pipe Storage and Coating Yards | 9 | 1 | 0 |
| Platform Fabrication Yards | 10 | 2 | 1 |
| Pipeline Landfalls | 30 | 0 | 7 |

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 618,800 bbl. |
| Cuttings | 362,630 bbl. |
| Formation Waters | 10.04-903.6 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 15,500 |
| New Population | none |

# Exploration and Development Assumptions
# Eastern Gulf of Mexico Planning Area

## Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 19 |
| Wells, Development and Production | 36 |
| Platforms | 2 |
| Pipelines to Shore - oil | 0 |
| - gas | 0 |

## Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | 4 | 1 | 1 |
| Heliports | 2 | 0 | 0 |
| Refineries | 1 | 0 | 0 |
| Gas Plants | 1 | 0 | 0 |
| Marine Terminals | 1 | 0 | 0 |
| Pipe Storage and Coating Yards | 1 | 0 | 0 |
| Platform Fabrication Yards | 1 | 0 | 0 |
| Pipeline Landfalls | 1 | 0 | 5 |

## Drilling Discharges

| | |
|---|---|
| Drill Muds | 250,250 bbl. |
| Cuttings | 7,018 bbl. |
| Formation Waters | 0.62-55.8 mbbl. |

## Socioeconomic Factors

| | |
|---|---|
| New Employment | 400 |
| New Population | 300 |

## Exploration and Development Assumptions
## Washington and Oregon Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 10 |
| Wells, Development and Production | 29 |
| Platforms | 1 |
| Pipelines to Shore - oil | 0 |
| - gas | 1 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | | 1 |
| Heliports | * | | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | * | | |
| Pipe Storage and Coating Yards | * | | |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | | 1 |

*Existing facilities are adequate.

### Drilling Discharges

| | |
|---|---|
| Drill Muds and Cuttings | 175,000 bbl. |
| Formation Waters | 43.5 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 1,176 |
| New Population | 1,450 |

## Exploration and Development Assumptions
## Northern California Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 20 |
| Wells, Development and Production | 48 |
| Platforms | 2 |
| Pipelines to Shore - oil | 0 |
| - gas | 1 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | | 2 |
| Heliports | * | | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | * | | |
| Pipe Storage and Coating Yards | * | | |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | | 1 |

*Existing facilities are adequate.

### Drilling Discharges

| | |
|---|---|
| Drill Muds and Cuttings | 306,000 bbl. |
| Formation Waters | 173.2 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 1,298 |
| New Population | 1,600 |

## Exploration and Development Assumptions
## Central California Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 11 |
| Wells, Development and Production | 30 |
| Platforms | 1 |
| Pipelines to Shore - oil | 0 |
| - gas | 0 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | | 1 |
| Heliports | * | | |
| Refineries | * | | |
| Gas Plants | - | - | - |
| Marine Terminals | * | | |
| Pipe Storage and Coating Yards | * | | |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | - | - | - |

*Existing facilities are adequate.

### Drilling Discharges

| | |
|---|---|
| Drill Muds and Cuttings | 185,000 bbl. |
| Formation Waters | 155.2 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 1,200 |
| New Population | 1,480 |

## Exploration and Development Assumptions
## Southern California Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 207 |
| Wells, Development and Production | 475 |
| Platforms | 10 |
| Pipelines to Shore - oil | 4 |
| - gas | 5 |

Gathering pipeline to existing platform.

## Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | 2 | | 2 |
| Heliports | * | | |
| Refineries | * | | |
| Gas Plants | | | 2 |
| Marine Terminals | * | | |
| Pipe Storage and Coating Yards | * | | |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | | 9 |

## Drilling Discharges

| | |
|---|---|
| Drill Muds and Cuttings | 3,070,000 bbl. |
| Formation Waters | 346.5 mbbl. |

## Socioeconomic Factors

| | |
|---|---|
| New Employment | 11,000 |
| New Population | 6,000 |

## Exploration and Development Assumptions
## Gulf of Alaska Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 12 |
| Wells, Development and Production | 42 |
| Platforms | 1 |
| Pipelines to Shore - oil | 1 |
| - gas | 1 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | 1 | |
| Heliports | | 1 | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | | 1 | |
| Pipe Storage and Coating Yards | | | 1 |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | | 2 |

*Existing facilities outside the Region

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 262,071 bbl. |
| Cuttings | 577,500 bbl. |
| Formation Waters | + 270 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 20-420 |
| New Population | 780 |

# Exploration and Development Assumptions
# Kodiak Planning Area

## Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 12 |
| Wells, Development and Production | 42 |
| Platforms | 1 |
| Pipelines to Shore - oil | 1 |
| - gas | 1 |

## Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | 1 | |
| Heliports | | 1 | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | | 1 | |
| Pipe Storage and Coating Yards | | | 1 |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | | 2 |

*Existing facilities outside the Region

## Drilling Discharges

| | |
|---|---|
| Drill Muds | 262,071 bbl. |
| Cuttings | 577,500 bbl. |
| Formation Waters | + 250 mbbl. |

## Socioeconomic Factors

| | |
|---|---|
| New Employment | 40-400 |
| New Population | 270 |

## Exploration and Development Assumptions
## Cook Inlet Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 10 |
| Wells, Development and Production | 23 |
| Platforms | 1 |
| Pipelines to Shore - oil | 1 |
| - gas | 1 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | 1 | |
| Heliports | | 1 | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | | 1 | |
| Pipe Storage and Coating Yards | | | 1 |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | 1 | 1 |

*Existing facilities outside the Region

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 184,429 bbl. |
| Cuttings | 530,833 bbl. |
| Formation Waters | + 250 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 100 to 525 |
| New Population | 300 |

## Exploration and Development Assumptions
## Shumagin Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 9 |
| Wells, Development and Production | 30 |
| Platforms | 1 |
| Pipelines to Shore - oil | 1 |
| - gas | 1 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | 1 | |
| Heliports | | 1 | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | | | 1 |
| Pipe Storage and Coating Yards | | | 1 |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | | 2 |

*Existing facilities outside the Region

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 189,857 bbl. |
| Cuttings | 417,321 bbl. |
| Formation Waters | + 250 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 30-250 |
| New Population | 130 |

## Exploration and Development Assumptions
## North Aleutian Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 12 |
| Wells, Development and Production | 39 |
| Platforms | 1 |
| Pipelines to Shore - oil | 1 |
| - gas | 1 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | 1 | |
| Heliports | | 1 | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | | 1 | |
| Pipe Storage and Coating Yards | | 1 | |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | 1 | |

*Existing facilities outside the Region

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 381,845 bbl. |
| Cuttings | 425,893 bbl. |
| Formation Waters | 3.7-330 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 20-440 |
| New Population | 170 |

## Exploration and Development Assumptions
## St. George Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 11 |
| Wells, Development and Production | 35 |
| Platforms | 1 |
| Pipelines to Shore - oil | 1 |
| - gas | 1 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | 1 | |
| Heliports | | 1 | |
| Refineries | * | | |
| Gas Plants | | 1 | |
| Marine Terminals | | 1 | |
| Pipe Storage and Coating Yards | | | 1 |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | 2 | |

*Existing facilities outside the Region

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 519,940 bbl. |
| Cuttings | 733,631 bbl. |
| Formation Waters | 17-1,500 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 97-585 |
| New Population | 640 |

## Exploration and Development Assumptions
## Navarin Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 82 |
| Wells, Development and Production | 229 |
| Platforms | 7 |
| Pipelines to Shore - oil | 1 |
| - gas | 1 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | 1 | |
| Heliports | | 1 | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | | 1 | |
| Pipe Storage and Coating Yards | | 1 | |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | | 1 |

*Existing facilities outside the Region

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 485,119 bbl. |
| Cuttings | 1,200,417 bbl. |
| Formation Waters | 10-150 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 200-4,000 |
| New Population | 325 |

## Exploration and Development Assumptions
## Norton Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 10 |
| Wells, Development and Production | 18 |
| Platforms | 1 |
| Pipelines to Shore - oil | 1 |
| - gas | 1 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | 1 | |
| Heliports | | 1 | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | | 1 | |
| Pipe Storage and Coating Yards | | | 1 |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | | 2 |

*Existing facilities outside the Region

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 106,905 bbl. |
| Cuttings | 101,190 bbl. |
| Formation Waters | 3.5-250 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 20-600 |
| New Population | 150 |

# Exploration and Development Assumptions
# Hope Planning Area

## Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 13 |
| Wells, Development and Production | 40 |
| Platforms | 1 |
| Pipelines to Shore - oil | 1 |
| - gas | 1 |

## Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | 1 | |
| Heliports | | 1 | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | | 1 | |
| Pipe Storage and Coating Yards | | | 1 |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | | 2 |

*Existing facilities outside the Region

## Drilling Discharges

| | |
|---|---|
| Drill Muds | 171,667 bbl. |
| Cuttings | 119,405 bbl. |
| Formation Waters | 5-250 mbbl. |

## Socioeconomic Factors

| | |
|---|---|
| New Employment | 30-750 |
| New Population | 200 |

# Exploration and Development Assumptions
# Chukchi Planning Area

## Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 37 |
| Wells, Development and Production | 105 |
| Platforms | 3 |
| Pipelines to Shore - oil | 1 |
| - gas | 0 |

## Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | | 1 |
| Heliports | | 1 | |
| Refineries | * | | |
| Gas Plants | - | - | - |
| Marine Terminals | | | 1 |
| Pipe Storage and Coating Yards | | | 1 |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | | 1 |

*Existing facilities outside the Region

## Drilling Discharges

| | |
|---|---|
| Drill Muds | 458,690 bbl. |
| Cuttings | 511,548 bbl. |
| Formation Waters | 10-500 mbbl. |

## Socioeconomic Factors

| | |
|---|---|
| New Employment | 4,000 |
| New Population | 1,500 |

# Exploration and Development Assumptions
# Beaufort Planning Area

## Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 22 |
| Wells, Development and Production | 61 |
| Platforms | 2 |
| Pipelines to Shore - oil | 1 |
| - gas | 0 |

## Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | 1 | | |
| Heliports | 1 | | |
| Refineries | * | | |
| Gas Plants | - | - | - |
| Marine Terminals | 1 | | |
| Pipe Storage and Coating Yards | 1 | | |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | | 1 |

*Existing facilities outside the Region

## Drilling Discharges

| | |
|---|---|
| Drill Muds | 154,762 bbl. |
| Cuttings | 344,345 bbl. |
| Formation Waters | 7.5 to 375 mbbl. |

## Socioeconomic Factors

| | |
|---|---|
| New Employment | 90-950 |
| New Population | 580 |

### b. Exploration and Development Assumptions for the Alternatives

#### (1) Alternative II - Subarea Deferrals

Resource estimates for the subareas considered for deferral under this alternative have not yet been developed. The analysis of the potential environmental impacts of this alternative has been done in a qualitative fashion, i.e., the kinds of potential impacts which would be avoided by deferral from leasing of these subareas have been identified and described, although no attempt has been made to quantify these impacts due to the current unavailability of resource estimates for each subarea. Resource estimates will be developed for further evaluation of subarea deferrals in the final EIS. The exploration and development assumptions and the resulting potential impacts of Alternative II, then, are assumed to be the same as for the proposal except as indicated in the qualitative discussions of impacts avoided by the deferral of eight additional subareas. These 13 subareas identified for further consideration as to their possible deferral (see Section II.A.2.a) are in the North, Mid-, and South Atlantic, Eastern Gulf of Mexico, Washington/Oregon, Northern and Central California, St. George, North Aleutian, and Beaufort Planning Areas. All other planning areas are unaffected by this alternative.

#### (2) Alternative III - Add A Sale in the Straits of Florida

This alternative evaluates the addition to the leasing schedule in Alternative I of a sale in the Straits of Florida Planning Area. The resource estimates and development timetable in Table IV.A.1-4 for the Straits of Florida and the assumptions below are for the entire planning area. However, the Secretary, in his decision on the Proposed Program chose to defer the Atlantic portion of the planning area from consideration for leasing in this 5-year program. As indicated in the previous subsection, resource estimates for subareas within planning areas have not yet been developed but will be available for analysis in the final EIS.

## Exploration and Development Assumptions
## Straits of Florida Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration and Delineation | 9 |
| Wells, Development and Production | 13 |
| Platforms | 1 |
| Pipelines to Shore - oil | 0 |
| - gas | 1 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | | 1 |
| Heliports | * | | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | * | | |
| Pipe Storage and Coating Yards | ** | | |
| Platform Fabrication Yards | ** | | |
| Pipeline Landfalls | | | 1 |

*Existing facilities are adequate
**Existing facilities--Gulf of Mexico

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 326,000 bbl. |
| Cuttings | 101,800 bbl. |
| Formation Waters | 420 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 1,500 |
| New Population | 3,900 |

### (3) Alternative IV - Biennial Leasing

The leasing schedule evaluated under this alternative provides for a biennial pace of leasing in those planning areas which have a triennial pace of leasing in Alternative I. Although this faster pace of leasing does not result in additional sales in all planning areas, the following planning areas would have an additional sale under this alternative: Mid- and South Atlantic, Eastern Gulf of Mexico, Southern and Central California, North Aleutian, St. George, Navarin, Norton, Chukchi, and Beaufort. Therefore, resource estimates for these 11 planning areas (Table IV.A.1-5) differ from those in the proposed action, as do the exploration and development assumptions which are presented below.

## Exploration and Development Assumptions
## Mid-Atlantic Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 17 |
| Wells, Development and Production | 21 |
| Platforms | 2 |
| Pipelines to Shore - oil | 0 |
| - gas | 1 |

Gathering pipelines included for single point mooring system.

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | 1 | | |
| Heliports | * | | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | * | | |
| Pipe Storage and Coating Yards | ** | | |
| Platform Fabrication Yards | ** | | |
| Pipeline Landfalls | | | 1 |

*Existing facilities are adequate
**Existing facilities outside the Region

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 622,700 bbl. |
| Cuttings | 167,680 bbl. |
| Formation Waters | 37.6 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 1,100 |
| New Population | 2,900 |

## Exploration and Development Assumptions
## South Atlantic Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 22 |
| Wells, Development and Production | 70 |
| Platforms | 2 |
| Pipelines to Shore - oil | 0 |
| - gas | 1 |

Gathering pipelines included for single point mooring system.

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | | 1 |
| Heliports | * | | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | * | | |
| Pipe Storage and Coating Yards | ** | | |
| Platform Fabrication Yards | ** | | |
| Pipeline Landfalls | | | 1 |

*Existing facilities are adequate
**Existing facilities outside the Region

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 1,332,000 bbl. |
| Cuttings | 413,200 bbl. |
| Formation Waters | 110.4 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 2,700 |
| New Population | 7,000 |

## Exploration and Development Assumptions
## Eastern Gulf of Mexico Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 28 |
| Wells, Development and Production | 51 |
| Platforms | 3 |
| Pipelines to Shore - oil | 0 |
| - gas | 0 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | 4 | 1 | 1 |
| Heliports | 2 | 0 | 0 |
| Refineries | 1 | 0 | 0 |
| Gas Plants | 1 | 0 | 0 |
| Marine Terminals | 1 | 0 | 0 |
| Pipe Storage and Coating Yards | 1 | 0 | 0 |
| Platform Fabrication Yards | 1 | 0 | 0 |
| Pipeline Landfalls | 1 | 0 | 0 |

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 360,000 bbl. |
| Cuttings | 10,080 bbl. |
| Formation Waters | 0.85-76.3 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 400 |
| New Population | 300 |

## Exploration and Development Assumptions
## Central California Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 20 |
| Wells, Development and Production | 43 |
| Platforms | 2 |
| Pipelines to Shore - oil | 0 |
| - gas | 0 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | | 1 |
| Heliports | * | | |
| Refineries | * | | |
| Gas Plants | - | - | - |
| Marine Terminals | * | | |
| Pipe Storage and Coating Yards | * | | |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | - | - | - |

*Existing facilities are adequate.

### Drilling Discharges

| | |
|---|---|
| Drill Muds and Cuttings | 285,000 bbl. |
| Formation Waters | 222.7 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 1,200 |
| New Population | 1,480 |

# Exploration and Development Assumptions
# Southern California Planning Area

## Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 231 |
| Wells, Development and Production | 525 |
| Platforms | 11 |
| Pipelines to Shore - oil | 4 |
| - gas | 5 |

Gathering pipeline to existing platform.

## Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | 2 | | 2 |
| Heliports | * | | |
| Refineries | * | | |
| Gas Plants | | | 2 |
| Marine Terminals | * | | |
| Pipe Storage and Coating Yards | * | | |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | | 9 |

## Drilling Discharges

| | |
|---|---|
| Drill Muds and Cuttings | 3,403,000 bbl. |
| Formation Waters | 393.5 mbbl. |

## Socioeconomic Factors

| | |
|---|---|
| New Employment | 11,000 |
| New Population | 6,000 |

# Exploration and Development Assumptions
# North Aleutian Planning Area

## Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 12 |
| Wells, Development and Production | 41 |
| Platforms | 1 |
| Pipelines to Shore - oil | 1 |
| - gas | 1 |

## Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | 1 | |
| Heliports | | 1 | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | | 1 | |
| Pipe Storage and Coating Yards | | 1 | |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | 1 | |

*Existing facilities outside the Region

## Drilling Discharges

| | |
|---|---|
| Drill Muds | 381,845 bbl. |
| Cuttings | 425,893 bbl. |
| Formation Waters | 3.7-330 mbbl. |

## Socioeconomic Factors

| | |
|---|---|
| New Employment | 20-440 |
| New Population | 170 |

# Exploration and Development Assumptions
## St. George Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 22 |
| Wells, Development and Production | 70 |
| Platforms | 2 |
| Pipelines to Shore - oil | 1 |
| - gas | 1 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | 1 | |
| Heliports | | 1 | |
| Refineries | * | | |
| Gas Plants | | 1 | |
| Marine Terminals | | 1 | |
| Pipe Storage and Coating Yards | | | 1 |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | 2 | |

*Existing facilities outside the Region

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 1,000,000 bbl. |
| Cuttings | 1,500,000 bbl. |
| Formation Waters | 34-3,000 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 1,000 |
| New Population | 1,200 |

# Exploration and Development Assumptions
# Navarin Planning Area

## Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 93 |
| Wells, Development and Production | 263 |
| Platforms | 8 |
| Pipelines to Shore - oil | 1 |
| - gas | 1 |

## Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | 1 | |
| Heliports | | 1 | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | | 1 | |
| Pipe Storage and Coating Yards | | 1 | |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | | 1 |

*Existing facilities outside the Region

## Drilling Discharges

| | |
|---|---|
| Drill Muds | 555,000 bbl. |
| Cuttings | 1,370,500 bbl. |
| Formation Waters | 12-170 mbbl. |

## Socioeconomic Factors

| | |
|---|---|
| New Employment | 250-4,100 |
| New Population | 370 |

# Exploration and Development Assumptions
## Norton Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 10 |
| Wells, Development and Production | 21 |
| Platforms | 1 |
| Pipelines to Shore - oil | 1 |
| - gas | 1 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | 1 | |
| Heliports | | 1 | |
| Refineries | * | | |
| Gas Plants | | | 1 |
| Marine Terminals | | 1 | |
| Pipe Storage and Coating Yards | | | 1 |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | | 2 |

*Existing facilities outside the Region

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 160,000 bbl. |
| Cuttings | 133,000 bbl. |
| Formation Waters | 4-300 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 20-600 |
| New Population | 150 |

## Exploration and Development Assumptions
## Chukchi Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 48 |
| Wells, Development and Production | 147 |
| Platforms | 4 |
| Pipelines to Shore - oil | 1 |
| - gas | 0 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | | | 1 |
| Heliports | | 1 | |
| Refineries | * | | |
| Gas Plants | - | - | - |
| Marine Terminals | | | 1 |
| Pipe Storage and Coating Yards | | | 1 |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | | 1 |

*Existing facilities outside the Region

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 550,000 bbl. |
| Cuttings | 544,000 bbl. |
| Formation Waters | 12-625 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 4,500 |
| New Population | 1,500 |

## Exploration and Development Assumptions
## Beaufort Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration | 22 |
| Wells, Development and Production | 65 |
| Platforms | 2 |
| Pipelines to Shore - oil | 1 |
| - gas | 0 |

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases | 1 | | |
| Heliports | 1 | | |
| Refineries | * | | |
| Gas Plants | - | - | - |
| Marine Terminals | 1 | | |
| Pipe Storage and Coating Yards | 1 | | |
| Platform Fabrication Yards | * | | |
| Pipeline Landfalls | | | 1 |

*Existing facilities outside the Region

### Drilling Discharges

| | |
|---|---|
| Drill Muds | 175,000 bbl. |
| Cuttings | 410,000 bbl. |
| Formation Waters | 10-405 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment | 90-950 |
| New Population | 580 |

### (4) Alternative V - Acceleration Provision

This alternative evaluates the potential impacts of implementation of the acceleration provision in those planning areas which have a triennial pace of leasing under Alternative I. It is assumed under this alternative that leasing in these planning areas would be accelerated to a biennial pace but no new sales would be added in any planning area. Therefore, resource estimates and exploration and development assumptions remain the same as for the proposal, although the development timetable would be accelerated by 1 year. The one exception to this rule is the Southern California Planning Area which shows a reduction in resource estimates for this alternative. This is due to the assumption stated in Section IV.A.1, that if sales in a planning area were to be altered from a triennial to biennial pace, the amount of exploratory information available before the next lease sale would be reduced and, therefore, the amount of resources expected to be leased would be reduced. The lower exploration and development assumptions for this planning area are presented below.

## Exploration and Development Assumptions
## Southern California Planning Area

### Offshore Infrastructure

| | |
|---|---|
| Wells, Exploration------------------- | 176 |
| Wells, Development and Production------ | 400 |
| Platforms----------------------------- | 10 |
| Pipelines to Shore - oil-------------- | 4 |
| - gas-------------- | 5 |

Gathering pipeline to existing platform.

### Onshore Infrastructure

| | Existing | Expanded | New |
|---|---|---|---|
| Support bases------------------------- | 2 | | 2 |
| Heliports----------------------------- | * | | |
| Refineries---------------------------- | * | | |
| Gas Plants---------------------------- | | | 2 |
| Marine Terminals---------------------- | * | | |
| Pipe Storage and Coating Yards--------- | * | | |
| Platform Fabrication Yards------------- | * | | |
| Pipeline Landfalls-------------------- | | | 9 |

### Drilling Discharges

| | |
|---|---|
| Drill Muds and Cuttings--------------- | 2,593,000 bbl. |
| Formation Waters---------------------- | 300 mbbl. |

### Socioeconomic Factors

| | |
|---|---|
| New Employment------------------------ | 11,000 |
| New Population------------------------ | 6,000 |

#### (5) Alternative VI - Defer Leasing in Six Planning Areas

This alternative evaluates a leasing schedule which defers leasing in six planning areas: North Atlantic, Washington/Oregon, Northern California, Central California, Southern California, and North Aleutian. The resource estimates and exploration and development information for the remaining planning areas are assumed to be the same as for Alternative I.

#### (6) Alternative VII - No Action

Under this alternative, it is assumed that no further oil and gas leasing would occur.

## 3. Projected Transportation and Markets

### a. Introduction

How oil and gas are transported to shore and/or markets is often an issue of considerable concern from both economic and environmental perspectives. The analysis of environmental impacts in all planning areas is significantly affected by the assumptions made concerning how oil and gas production will be transported to shore and whether production will be tankered or pipelined to markets inside or outside of the planning area. The analysis of oil spills, which is presented in Section IV.A.4.a incorporates detailed assumptions concerning how oil will be transported to shore and how oil will be transported to markets. The transportation Modes Column in the tables provides the transportation scenarios for each planning area. These transportation scenarios have considerable effect on the estimated number of oil spills (greater than 1,000 barrels) both within and between planning areas.

In analyzing the availability of transportation networks to deliver oil and gas to demand areas, both current and proposed networks were reviewed for all OCS planning areas. In addition, data submitted by State and local governments, Federal Agencies, industry, and the public in response to letters to the Governors of affected States and to the heads of relevant Federal Agencies, dated July 5, 1984, and a July 11, 1984, Federal Register Request for Comments Notice were also used. The results of this analysis have confirmed that the decision of whether to use pipelines, barges, or tankers to transport OCS oil and gas to shore is dependent on a number of factors, including technological constraints, environmental preferences, and economic considerations. The exact mode of transport cannot be determined until the amount of recoverable reserves is known and judgments are made as to what is environmentally preferable and technically and economically feasible.

Further, it is understood that, in order for a hydrocarbon find to be economically feasible, an accessible transportation system must be in existence or a new one must be created. Transportation systems are not built in anticipation of hydrocarbon discoveries. This is especially true in frontier areas where knowledge of hydrocarbon resources is spotty or nonexistent and anticipated transportation costs are generally very high due to the lack of existing infrastructure.

Based on previous analysis and completed projects, pipelines are generally preferred by the oil companies for transporting oil and gas to processing facilities when economics and other considerations justify their construction. Where pipelines cannot be justified, tankers or barges are necessary. In California, although pipelines have almost always been used over tankers, in some instances tankers are preferred by the oil industry. Tankers, in some cases, allow greater flexibility in terms of getting oil to refineries and market centers. Not all of the oil companies have local refineries or local refineries with the capability of handling high sulfur or heavy crude like those being found off California.

The present analysis is limited to examination of issues related to transport of product among domestic market areas. There has been extensive public debate for and against sale and transport of Alaskan OCS crude oil to Japan. Such sales currently are generally prohibited by Federal law. If authorized, OCS oil and gas resources could be delivered more cheaply to Japan than to many domestic market areas.

### b. Transporting Oil and Gas Resources to Shore

At present, pipelines are generally used to bring oil and gas ashore in both the Gulf of Mexico and Southern California Planning Areas. The Gulf of Mexico is the only area with an extensive pipeline system, including a network of oil- and gas-gathering systems and trunk lines. In Southern California, the only other commercially producing OCS area, pipelines are desirable because, once installed, they generally do not adversely affect air quality commonly associated with tanker terminal use. The State of California also prefers pipelines due to their belief that there is a lower risk of oil spills. However, tankers are employed in Southern California in a variety of situations to transport oil to refineries.

Expansion of the offshore oil and gas pipeline systems in Southern California and the Gulf of Mexico is continuing as needed to extend pipelines into new production areas. For example, a number of discoveries have been announced in the Santa Maria Basin on the California OCS. As as result, several large production projects are expected to be coming on line in the near future and are likely to transport oil and gas ashore by new pipelines to a consolidated onshore processing facility. Also, OCS development support facilities within California are being consolidated to minimize the number of pipeline landfalls. Similarly, any new production in the Central and Western Gulf of Mexico is also expected to use pipelines. In many cases, the only new gathering lines likely to be required in the Gulf of Mexico region are to connect with existing trunk systems.

The specific transportation modes scenarios used for the Western and Central Gulf of Mexico and Southern California have from 20 percent (Central Gulf of Mexico) to 34 percent of oil production being tankered to shore. These percentages of oil production tankered to shore reflect early production prior to pipeline completions and both the possible production from fields which cannot use pipelines for economic, physical (water depth), and environmental reasons.

In areas where there is currently no production, such as the Atlantic OCS, alternative transportation system may be required. Because of both the size and location of potential Atlantic OCS fields, it is expected that all Atlantic OCS crude would be transported via pipelines to common offshore loading points and then transported to shore by tankers. The same is likely to be true for any oil found where the resources may not economically justify pipelines, for example in Central and Northern California and in the Eastern Gulf of Mexico. See the tables in Section IV.A.4.a for specifics.

As there is not yet any oil and gas production on the Alaksa OCS, transportation systems there are still speculative. However, three basic networks have been identified based on geography. The first involves oil and gas transportation from the Beaufort Sea, Chukchi Sea, and Hope Basin Planning Areas. Produced crude oil is expected to be transported through subsea and overland pipelines to the Trans-Alaskan Pipeline System (TAPS), where it would be routed to the Valdez tanker terminal.

Ice-breaking tankers are still being considered as a viable option to pipelines in many of the planning areas in Alaska including the western portion of the Chukchi Sea and Hope Basin. Tankering may be economically viable and may be the form of transportation selected by industry in Alaska as it was selected, for example, in the North Sea for marginal fields in their initial stage of production.

Anticipated OCS production is not likely to exceed TAPS capacity and is expected to actually replace production from the Alaskan North Slope (ANS) which is estimated to decline rapidly in the late 1990's. The TAPS began transporting crude oil from the ANS to Valdez on June 10, 1977. TAPS is a 48-inch diameter line designed to have a potential capacity of 2.0 million barrels per day, although 1.7 million barrels per day has been set as the maximum efficient rate by the Alaska Oil and Gas Conservation Commission.

The terminal at Valdez is able to handle four tankers at one time and has an average turnaround time of 24 hours. TAPS is presently delivering crude oil from Prudhoe Bay which initially had an estimated 9.6 billion barrels of recoverable oil reserves and from Kuparuk which had an estimated 1.6 billion barrels of recoverable oil reserves.

The second oil transportation scenario for Alaska encompasses possible production within the St. George Basin, Norton Sound, Navarin Basin and the North Aleutian Basin Planning Areas. Transportation projections for these planning areas feature a series of gathering and trunk lines feeding into a central offshore or onshore terminal. Ice-breaking shuttle tankers would be used to move the crude to an ice-free deepwater port on the Southern Alaskan peninsula for transshipment. As an alternative, it is possible that potential OCS production from the North Aleutian Basin would be piped directly to the transshipment terminal.

As another alternative, industry is currently indicating that ice-breaking tankers could be used to transport the product directly to market, without using any shuttle tankers, which minimizes the problems with potential spills associated with unloading and reloading. The vessels can use a variable pitch propeller system, which will give them power in the ice and speed in the open water.

The transportation of crude oil from OCS operations in the Bering Sea would require the construction of new tanker facilities. While weather conditions are severe in these areas, sea conditions would not preclude the use of conventional tankers during most of the year. The supply of tankers is not expected to pose a constraint on development of leases issued during the 1986-1991 time period.

The third scenario includes the Shumagin Basin, Kodiak, Cook Inlet, and Gulf of Alaska Planning Areas. If production from these OCS areas were to occur, it would likely be moved through subsea pipelines to storage facilities prior to being tankered directly to market. Some new tanker facilities would likely be required.

There is currently no system available to transport natural gas from the Prudhoe Bay area of the Alaska OCS to the contiguous United States. Based on current cost/price relationships and foreseeable technological advances the gas resources estimates for the Beaufort Sea and Chukchi Sea Planning Areas are assumed in this analysis to be uneconomic. The Alaskan Natural Gas Transportation System (ANGTS) had been proposed to carry North Slope and Canadian natural gas to the lower 48 States. The pipeline is currently delivering gas from north of Clagary, Alberta, to Iowa and Oregon. However, the Alaskan and northern Canadian sections of the pipeline remain unbuilt. Sponsors of the ANGTS have announced delay in the target date for comple-tion of the line, citing inability to obtain funding. Some analysts argue that the pipeline's estimated cost makes completion of the project economically impractical. Others contend that current economic conditions have only delayed its completion. If completed, the pipeline would carry North Slope and Canadian natural gas to markets as far away as Chicago and San Francisco. Another pipeline, the all Alaska Natural Gas Pipeline, has been proposed to transport the North Slope gas to Kenai, Alaska, for processing and transportation. The assessments of environmental impacts for the Beaufort and Chukchi Planning Areas assumes that gas production would not be economic due to expected high transportation costs.

In the absence of a pipeline, other gas transportation systems are being considered including liquefaction of natural gas (LNG) and conversion of gas to methanol. Industry indicates that the technology exists to use gathering lines to a grounded barge with prefabricated facilities for processing, storage, and conversion and to then tanker LNG to a terminal. The major problems lie in operating tankers in a hostile environment. Tankers designed with ice breaking capability and otherwise modified for operations in an arctic environment are believed to be feasible.

LNG terminals could also be mounted on an offshore platform, although offshore fixed storage and loading facilities are only in the conceptual stage of development. The technology for an LNG transfer system from a fixed platform to floating storage or tankers appears to be available for Alaskan offshore waters but has not been proven. Onshore LNG terminals now exist in Quincy, Massachusetts; Cove Point, Maryland; and Savannah, Georgia.

### c. Transportation to Markets

Because of both the size and location of anticipated Atlantic OCS fields it is anticipated that all Atlantic OCS crude will be transported via tankers to refineries in the Middle Atlantic Planning Area. Anticipated peak production from Atlantic OCS fields would occur early in the next century at approximately 300,000 barrels per calendar day (bcd). Existing Atlantic coast refineries have crude oil capacity of approximately 1.4 million bcd. Thus, even though Atlantic coast refining capacity has declined in recent years, it is assumed that Atlantic OCS oil production will be refined and marketed along the Atlantic coast.

The existing refinery and continental pipelines system in the Gulf Coast imposes no constraint on processing and distribution of anticipated OCS production. It is assumed that all Gulf OCS production will be landed in the Gulf and processed and distributed in response to market conditions. For a variety of reasons, more detailed analysis is required for West Coast OCS production, and provided later in this section.

Transportation networks do not pose a major constraint to further subarctic OCS production, as they will be modified to serve economically viable hydrocarbon discoveries. The availability of current transportation networks will, in fact, facilitate the development of OCS resources which can make use of those networks. The factors restricting transportation network availability and, potentially, OCS production, will be the environmental and economic costs associated with establishing and operating the necessary transportation systems. Transportation costs and availability are carefully considered when evaluating the economic feasibility of every hydrocarbon discovery. Resource development will not occur unless the hydrocarbons can be economically transported to regional and national markets.

Specific assumptions are made to allocate OCS oil production between West and Gulf Coast refineries. A forecast of Petroleum Administration for Defense District (PAD) V (Alaska, Hawaii, Washington, Oregon, California, Arizona, and Nevada) refining capacity is used as an upper bound on deliveries of OCS oil. Both onshore and OCS production from California, Oregon, and Washington are allocated to PAD V refineries. Alaska OCS oil and other Alaskan oil are allocated to excess PAD V refinery capacity proportionately. The excess PAD V refinery capacity is calculated by subtracting the estimated production in California, Oregon, and Washington from the PAD V refining capacity. Most Alaskan and West Coast production not refined in PAD V is expected to be delivered to the Gulf Coast area for refining. An extensive pipeline system originating in the Gulf along with transport of refined products by barge and tanker will allow delivery to market centers throughout much of the country.

In 1984, there were 47 operating refineries in PAD V with 4 idle refineries. Six refineries in PAD V became inoperable between 1983 and 1984.

The 47 operating refineries in PAD V produced 2.460 million b/d of products during 1984 and the total capacity of operating and idle refineries was 2.995 million b/d. The decline in PAD V refinery capacity during 1984 was consistent with a nationwide pattern of reduced refinery capacity which started in 1981. Over the 5-year period, national refining capacity dropped by almost 22 percent (Oil and Gas Journal, March 18, 1985).

Explicit assumptions concerning future refining capacity and demand for petroleum in PAD V will provide a basis for estimating how much West Coast OCS oil will likely be refined and consumed on the West Coast and how much West Coast OCS oil will likely be shipped to the Gulf Coast for refining and use. The Department of Energy was consulted to obtain a forecast of future petroleum consumption in PAD V. Across all petroleum consuming sections, the demand for refined products in PAD V is estimated to be approximately 2.75 million b/d in the year 2000 and 2.6 million b/d in the year 2010.

The PAD V consumption forecast must be augmented by a forecast of future export of refined products to have an estimate of total future PAD V refining capacity. In 1984, PAD V had net product export of 122.7 thousand b/d. Thus, net exports amount to approximately 4.5 percent of total refinery production. Increasing the forecast demand for petroleum production in the years 2000 and 2010 by 4.5 percent would increase the refinery production estimate to 2.87 million b/d in 2000 and 2.7 million b/d in 2010. The Department of Energy has not forecast expected future product exports from PAD V. Estimates of approximately 2.9 million b/d in 2000 and 2.7 million b/d in 2010 will be used in allocating Alaskan and West Coast OCS oil between PAD V refineries and refineries in the Gulf of Mexico.

It is perhaps, relevant to note that the estimate of 2.9 million b/d for the year 2000 is slightly less than the total capacity of operating and idle refineries in PAD V during 1984. Between 1984 and 2000, PAD V refining capacity is assumed to equal 2.9 million b/d, and a straight line decline is assumed between 2000 and 2010.

The estimated total production in PAD V exceeds expected PAD V refining capacity past the year 2010. Transportation of part of the PAD V surplus by pipelines is expected. There are presently three proposed pipelines in various stages of the complex procedures for obtaining necessary permits. The proposed projects include the all American Pipeline from Santa Barbara, California, to Midland, Texas, with a 300,000 b/d capacity; the Pacific-Texas pipeline from Long Beach, California, To Midland, Texas, with a proposed through put of 900,000 b/d; and the expansion of the existing Four Corners pipelines to a proposed capacity of 150,000 b/d from Long Beach to New Mexico. For purposes of this analysis, it is assumed that pipeline transportation for PAD V oil will be operational by 1995. The capacity of pipeline transportation assumed in this analysis is 500,000 b/d.

Demonstration of the method for allocating Alaskan oil to West and Gulf Coast refineries is provided by explaining the calculations for the year

2000 which use $29/barrel resource estimates. PAD V refining capacity is estimated to be 2.9 million b/d. Additionally, 0.5 million b/d of pipeline capacity is assumed. Production for the Pacific OCS (all three California planning areas plus Washington and Oregon) is estimated to be 0.377 million b/d and onshore production is estimated to be 2.384 million b/d. Subtracting these estimates of 2000 production from the estimate of PAD V refining and pipeline capacity provides an estimate of surplus PAD V refining capacity--0.639 million b/d. This surplus is allocated between Alaska OCS and Alaska onshore oil proportionately which results in 0.048 million b/d of the estimated 0.134 million b/d being allocated to PAD V refineries with the rest going to the Gulf of Mexico PAD III refineries. Similar calculations were made for each year between 1995 and 2010. After 2010 all Alaskan OCS oil production can be refined in PAD V. Summing across the period 1995 - 2020 produces an estimate of the total amount of Alaska OCS oil that is allocated to West and Gulf Coast refineries. The results for $29/barrel oil price estimates are that 486 million barrels of Alaska OCS oil production can be delivered to PAD V refineries and 270 million barrels will have to be shipped to PAD III for refining.

In the past, concern has been expressed that the low gravity, high sulfur, crude oil found on the California OCS and the low gravity oil from the Alaska North Slope could not be refined in most California refineries without violating California air quality standards. Retrofitting refineries to allow operations to meet air quality standards while processing lower quality crudes is expensive. Still, some California refineries are currently being modified to handle the lower quality crude oil expected to be produced in the near future.

### 4. Oil Spills

#### a. Oil Spill Analysis

Oil spills are considered one of the single greatest potential impacting agents to the environment from offshore oil and gas activities. Oil spills can potentially impact resources ranging from biologically sensitive habitats and endangered species to recreational beaches or military operating areas. As a result, MMS has developed the Oil Spill Risk Analysis Model (OSRAM) (LaBelle et al., 1983; Smith et al., 1982; Lanfear et al., 1979) as a tool to aid in the overall understanding of the potential risk of oil spills to the environment from specific offshore oil and gas lease sales.

The OSRAM is a means of quantifying the potential risks of oil spills resulting from the proposed action, as well as from existing leases and oil imports. In view of computer-related constraints, the approach to oil spill modeling used for this 5-Year EIS was to use only the estimated number of oil spills (greater than 1,000 barrels) and the estimated probability of one or more spills (greater than 1,000 barrels). Thus, the oil spill trajectory part of the OSRAM was not used in this analysis. An understanding of the uncertainties and assumptions about both the data used as input to the model used in this analysis and the resultant output data is necessary in order to make the subsequent analyses meaningful.

The model assumptions include: (1) reasonable resource estimates can be made from knowledge of the general geologic formations where in some cases no test wells have been drilled; (2) the best estimate of what may happen in the future in terms of accidental oil spill rates can be based on past U.S. OCS activity and worldwide tankering activitiy (only spills of 1,000 bbls or greater are taken into account); (3) the best exposure variable for risk assessment in all activity modes (platforms, tankers, and pipelines) is volume of oil produced and transported; and (4) spill occurrence is assumed to follow a Poisson distribution. The oil spill model is described in more detail in the reports mentioned above and briefly below. The model used in this analysis categorizes spills into volume classes: only oil spills greater than or equal to 1,000 bbls are considered. Most spills are in the range of 1-1,000 bbls, and are usually the result of transferring or lightering operations, and are reported a lower percentage of the time than larger spills. The size class of spills occurs most often near ports where cleanup capabilities are best. Spills of this size class will respond quickest to natural forces (evaporation, spreading and diffusion, sinking, mixing, biodegradation, photochemical oxidation, etc.) and cleanup efforts, and often will not be discernable within a very short amount of time. This analysis does not model these smaller spills.

Another important assumption the model incorporates is that historical oil spill accident rates can be used to predict future spills. The accident data are separated into three modes: production (platforms), pipelines, and tankers. It is very important to consider oil transport as well as production, since actual production is just one part of the process which results in possible oil spills and environmental risk. The historical spill rates from U.S. OCS activity are used to estimate spills from production and pipelines, and the worldwide tankering spill rate is used to estimate spills from tanker transportation (as the model includes risk from import tankering and tankering anticipated from the proposal).

The model assumes that 50 percent of the spills from tankers will occur in the study area if the tanker makes only a single port call in the study area. The historical spill rates for platforms and pipelines come from both the Gulf of Mexico and Southern California, where all Federal offshore production, and, therefore, accidental spills have occurred.

The entire U.S. OCS is subject to the same regulations and has access to the same level of technology (the most advanced in the world) and is generally believed to accept the same risk. To date, no oil spills of 1,000 bbls or greater have been attributed to geohazards (earthquakes, slumps, shallow gas) on the U.S. OCS. The historical spill rates have shown significant improvement over the past 10 years (Lanfear and Amstutz, 1983). This improving record is possibly a result of advancing technology of the industry, as well as the more rigorous environmental regulations.

The results of the oil spill model used in this 5-Year EIS are summarized in tables IV.A.4.a.1 - IV.A..4.a.6. Table IV.A.4.a.1 provides the results for Alternative 1 (the Proposal). Table IV.A.4.a.2 provides the results for the cumulative impact analysis; table IV.A.4.a.3 is the high case;

Table IV.A.4.a.1

Alternative 1 - The Proposed Action

Estimated Number of Oil Spills Greater Than 1,000 Barrels and Probability of One or More Spills[1]

| Planning Areas | Conditional Oil Resources | | Transportation Modes[2] | Spills from OCS Activities Within Planning Areas | | | | | Spills between Planning Areas | | Total Spills from Proposal in Each Area | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Total | | | | | |
| | Millions of barrels | MPHC | | Platforms[3] | Pipelines[3] | Tankers[3] | Num. | Prob. | Num. | Prob. | Num. | Prob. |
| N. Atlantic | 49 | 0.30 | P+T4 | 0.05 | 0.08 | 0.03 | 0.16 | 0.15 | -- | -- | 0.16 | 0.15 |
| Mid-Atlantic | 25 | 1.00 | P+T4 | 0.02 | 0.04 | 0.03 | 0.10 | 0.09 | 0.02 | 0.02 | 0.12 | 0.11 |
| S. Atlantic | 69 | 0.25 | P+T4 | 0.07 | 0.11 | 0.04 | 0.22 | 0.20 | -- | -- | 0.22 | 0.20 |
| W. GOM | 437 | 1.00 | 25T75P | 0.44 | 0.52 | 0.14 | 1.10 | 0.67 | 0.20 | 0.18 | 1.30 | 0.73 |
| C. GOM | 1004 | 1.00 | 20T80P | 1.00 | 1.28 | 0.26 | 2.55 | 0.92 | 0.18 | 0.16 | 2.73 | 0.93 |
| E. GOM | 62 | 1.00 | T | 0.06 | -- | 0.04 | 0.10 | 0.10 | -- | -- | 0.10 | 0.10 |
| Wash./Oregon | 58 | 0.20 | T | 0.06 | -- | 0.08 | 0.13 | 0.12 | 0.08 | 0.08 | 0.22 | 0.10* |
| N. Calif | 231 | 0.60 | T | 0.23 | -- | 0.15 | 0.38 | 0.32 | -- | -- | 0.38 | 0.32 |
| C. Calif | 207 | 0.65 | T | 0.21 | -- | 0.27 | 0.48 | 0.38 | 0.27 | 0.23 | 0.74 | 0.44* |
| S. Calif | 462 | 1.00 | 34T66P | 0.46 | 0.49 | 0.20 | 1.15 | 0.68 | 0.23 | 0.21 | 1.39 | 0.75 |
| Gulf of Alaska | 113 | 0.08 | P+T | 0.11 | 0.18 | 0.07 | 0.37 | 0.31 | 0.44 | 0.35 | 0.80 | 0.37* |
| Kodiak | 95 | 0.05 | P+T | 0.10 | 0.15 | 0.06 | 0.31 | 0.26 | -- | -- | 0.31 | 0.26 |
| Cook Inlet | 179 | 0.03 | P+T | 0.18 | 0.29 | 0.12 | 0.58 | 0.44 | -- | -- | 0.58 | 0.44 |
| Shumagin | 48 | 0.03 | P+T | 0.05 | 0.08 | 0.03 | 0.16 | 0.14 | 0.76 | 0.53 | 0.92 | 0.53* |
| N. Aleutian | 173 | 0.20 | P+T[8] | 0.17 | 0.28 | -- | 0.45 | 0.36 | -- | -- | 0.45 | 0.36 |
| St. George | 135 | 0.22 | 50T50P+T[7] | 0.14 | 0.11 | 0.04 | 0.29 | 0.25 | 0.24 | 0.21 | 0.53 | 0.27* |
| Navarin | 1920 | 0.27 | P+T+T[6] | 1.92 | 3.07 | 0.38 | 5.38 | 0.99+ | -- | -- | 5.38 | 0.99+ |
| Norton | 102 | 0.15 | P+T+T[6] | 0.10 | 0.16 | 0.02 | 0.29 | 0.25 | -- | -- | 0.29 | 0.25 |
| Hope | 145 | 0.02 | P+T[5] | 0.14 | 0.23 | -- | 0.38 | 0.31 | -- | -- | 0.38 | 0.31 |
| Chukchi Sea | 1152 | 0.20 | P+T[5] | 1.15 | 1.84 | -- | 3.00 | 0.95 | -- | -- | 3.00 | 0.95 |
| Beaufort | 627 | 0.70 | P+T[5] | 0.63 | 1.00 | -- | 1.63 | 0.80 | -- | -- | 1.63 | 0.80 |

Table IV.A.4.a.2
Cumulative Impacts Case
Estimated Number of Oil Spills Greater than 1,000 Barrels and Probability of One or More Spills[1]

| Planning Areas | Conditional Oil Resources | | Transportation Modes[2] | Spills from OCS Activities Within Planning Areas | | | | | Tanker Spills from | | | | | | Total Spills from All Sources | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Millions of barrels | MPHC | | Platforms[3] | Pipelines[3] | Tankers[3] | Total | | Proposal | | Other Domestic | | Imports | | | |
| | | | | | | | Num. | Prob. | Num. | Prob. | Num. | Prob. | Num. | Prob. | Num. | Prob. |
| N. Atlantic | 260 | 0.30 | P+T4 | 0.26 | 0.42 | 0.17 | 0.84 | 0.57 | -- | -- | 0.49 | 0.39 | 1.56 | 0.79 | 2.90 | 0.94 |
| Mid-Atlantic | 360 | 1.00 | P+T4 | 0.36 | 0.58 | 0.47 | 1.40 | 0.75 | 0.92 | 0.60 | 2.46 | 0.92 | 16.78 | 0.99+ | 21.56 | 0.99+ |
| S. Atlantic | 860 | 0.25 | P+T4 | 0.86 | 1.38 | 0.56 | 2.80 | 0.94 | -- | -- | 0.75 | 0.53 | 1.24 | 0.71 | 4.78 | 0.99 |
| W. GOM | 2127 | 1.00 | 25T75P | 2.13 | 2.55 | 0.69 | 5.37 | 0.99+ | 0.53 | 0.41 | 2.46 | 0.92 | 14.42 | 0.99+ | 22.78 | 0.99+ |
| C. GOM | 7082 | 1.00 | 20T80P | 7.08 | 9.06 | 1.84 | 17.99 | 0.99+ | 0.63 | 0.46 | 1.67 | 0.81 | 12.55 | 0.99+ | 32.84 | 0.99+ |
| E. GOM | 410 | 1.00 | T | 0.41 | -- | 0.27 | 0.68 | 0.49 | -- | -- | -- | -- | 0.23 | 0.21 | 0.91 | 0.60 |
| Wash./Oregon | 180 | 0.20 | T | 0.18 | -- | 0.23 | 0.41 | 0.34 | 0.22 | 0.20 | 0.63 | 0.47 | 1.64 | 0.81 | 2.90 | 0.92* |
| N. Calif. | 420 | 0.60 | T | 0.42 | -- | 0.27 | 0.69 | 0.50 | -- | -- | -- | -- | -- | -- | 0.69 | 0.50 |
| C. Calif. | 560 | 0.65 | T | 0.56 | -- | 0.73 | 1.29 | 0.72 | 0.63 | 0.47 | 1.34 | 0.74 | 1.21 | 0.70 | 4.47 | 0.98* |
| S. Calif. | 2973 | 1.00 | 34T66P | 2.97 | 3.14 | 1.31 | 7.42 | 0.99+ | 0.60 | 0.45 | 1.74 | 0.82 | 2.39 | 0.90 | 12.16 | 0.99+ |
| Gulf of Alaska | 540 | 0.08 | P+T | 0.54 | 0.86 | 0.35 | 1.76 | 0.83 | 0.93 | 0.61 | 6.55 | 0.99+ | -- | -- | 9.24 | 0.99+* |
| Kodiak | 150 | 0.05 | P+T | 0.15 | 0.24 | 0.10 | 0.49 | 0.38 | -- | -- | -- | -- | -- | -- | 0.49 | 0.38 |
| Cook Inlet | 210 | 0.03 | P+T | 0.21 | 0.34 | 0.27 | 0.82 | 0.56 | -- | -- | -- | -- | -- | -- | 0.82 | 0.56 |
| Shumagin | 50 | 0.03 | P+T | 0.05 | 0.08 | 0.03 | 0.16 | 0.15 | 1.07 | 0.66 | -- | -- | -- | -- | 1.23 | 0.66* |
| N. Aleutian | 360 | 0.02 | P+T[3] | 0.36 | 0.58 | -- | 0.94 | 0.61 | -- | -- | -- | -- | -- | -- | 0.94 | 0.61 |
| St. George | 1690 | 0.22 | 50T50P+T[7] | 1.69 | 1.35 | 0.55 | 3.59 | 0.97 | 0.66 | 0.48 | -- | -- | -- | -- | 4.25 | 0.76* |
| Navarin | 4800 | 0.27 | P+T+T[6] | 4.80 | 7.68 | 0.96 | 13.44 | 0.99+ | -- | -- | -- | -- | -- | -- | 13.44 | 0.99+ |
| Norton | 640 | 0.15 | P+T+T[6] | 0.64 | 1.02 | 0.13 | 1.79 | 0.83 | -- | -- | -- | -- | -- | -- | 1.79 | 0.83 |
| Hope | 170 | 0.02 | P+T[5] | 0.17 | 0.27 | -- | 0.44 | 0.36 | -- | -- | -- | -- | -- | -- | 0.44 | 0.36 |
| Chukchi Sea | 2680 | 0.02 | P+T[5] | 2.68 | 4.29 | -- | 6.97 | 0.99+ | -- | -- | -- | -- | -- | -- | 6.97 | 0.99+ |
| Beaufort | 1280 | 0.70 | P+T[5] | 1.28 | 2.05 | -- | 3.33 | 0.96 | -- | -- | -- | -- | -- | -- | 3.33 | 0.96 |
| Straits of FL | 21 | 0.11 | T | 0.02 | -- | 0.03 | 0.05 | 0.05 | -- | -- | 0.44 | 0.36 | 0.34 | 0.29 | 0.83 | 0.54* |

## Table IV.A.4.a.3
### High Case
### Estimated Number of Oil Spills Greater Than 1,000 Barrels and Probability of One or More Spills[1]

| Planning Areas | Conditional Oil Resources | | Transportation Modes[2] | Spills from OCS Activities Within Planning Areas | | | | | Spills between Planning Areas | | Total Spills from Proposal in Each Area | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Millions of barrels | MPHC | | Platforms[3] | Pipelines[3] | Tankers[3] | Total Num. | Total Prob. | Num. | Prob. | Num. | Prob. |
| N. Atlantic | 260 | 0.30 | P+T4 | 0.26 | 0.42 | 0.17 | 0.84 | 0.57 | -- | -- | 0.84 | 0.57 |
| Mid-Atlantic | 200 | 1.00 | P+T4 | 0.20 | 0.32 | 0.26 | 0.78 | 0.54 | 0.18 | 0.17 | 0.96 | 0.62 |
| S. Atlantic | 820 | 0.25 | P+T4 | 0.82 | 1.31 | 0.53 | 2.57 | 0.92 | -- | -- | 2.57 | 0.92 |
| W. GOM | 1320 | 1.00 | 25T75P | 1.32 | 1.58 | 0.43 | 3.33 | 0.96 | 0.33 | 0.28 | 3.66 | 0.97 |
| C. GOM | 2110 | 1.00 | 20T80P | 2.11 | 2.70 | 0.55 | 5.36 | 0.99+ | 0.42 | 0.34 | 5.78 | 0.99+ |
| E. GOM | 300 | 1.00 | T | 0.30 | -- | 0.20 | 0.50 | 0.39 | -- | -- | 0.50 | 0.39 |
| Wash./Oregon | 180 | 0.20 | T | 0.18 | -- | 0.23 | 0.41 | 0.34 | 0.13 | 0.13 | 0.55 | 0.20* |
| N. Calif | 420 | 0.60 | T | 0.42 | -- | 0.27 | 0.69 | 0.50 | -- | -- | 0.69 | 0.50 |
| C. Calif | 560 | 0.65 | T | 0.56 | -- | 0.73 | 1.29 | 0.72 | 0.45 | 0.36 | 1.73 | 0.72* |
| S. Calif | 1260 | 1.00 | 34T66P | 1.26 | 1.33 | 0.56 | 3.15 | 0.96 | 0.37 | 0.31 | 3.52 | 0.97 |
| Gulf of Alaska | 490 | 0.08 | P+T | 0.49 | -- | 0.32 | 0.81 | 0.55 | 0.65 | 0.48 | 1.45 | 0.51* |
| Kodiak | 150 | 0.05 | P+T | 0.15 | -- | 0.10 | 0.25 | 0.22 | -- | -- | 0.25 | 0.22 |
| Cook Inlet | 180 | 0.03 | P+T | 0.18 | -- | 0.12 | 0.30 | 0.26 | -- | -- | 0.30 | 0.26 |
| Shumagin | 50 | 0.03 | P+T | 0.05 | -- | 0.03 | 0.08 | 0.08 | 0.66 | 0.48 | 0.74 | 0.48* |
| N. Aleutian | 190 | 0.20 | P+T[3] | 0.19 | 0.30 | -- | 0.49 | 0.39 | -- | -- | 0.49 | 0.39 |
| St. George | 640 | 0.22 | 50T50P+T[7] | 0.64 | 0.51 | 0.21 | 1.36 | 0.74 | 0.42 | 0.35 | 1.78 | 0.51* |
| Navarin | 3280 | 0.27 | P+T+T[6] | 3.28 | 5.25 | 0.66 | 9.18 | 0.99+ | -- | -- | 9.18 | 0.99+ |
| Norton | 130 | 0.15 | P+T+T[6] | 0.13 | 0.21 | 0.03 | 0.36 | 0.30 | -- | -- | 0.36 | 0.30 |
| Hope | 170 | 0.02 | P+T[5] | 0.17 | 0.27 | -- | 0.44 | 0.36 | -- | -- | 0.44 | 0.36 |
| Chukchi Sea | 2680 | 0.20 | P+T[5] | 2.68 | 4.29 | -- | 6.97 | 0.99+ | -- | -- | 6.97 | 0.99+ |
| Beaufort | 650 | 0.70 | P+T[5] | 0.65 | 1.04 | -- | 1.69 | 0.82 | -- | -- | 1.69 | 0.82 |
| Straits of FL | 21 | 0.11 | T | 0.02 | -- | 0.03 | 0.05 | 0.05 | -- | -- | 0.05 | 0.05 |

Table IV.A.4.a.4
Alternative 3 - Add A Sale in Straits of Florida
Estimated Number of Oil Spills Greater Than 1,000 Barrels and Probability of One or More Spills[1]

| Planning Areas | Conditional Oil Resources | | Transportation Modes[2] | Spills from OCS Activities Within Planning Areas | | | | | Spills between Planning Areas | | Total Spills from Proposal in Each Area | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Millions of barrels | MPHC | | Platforms[3] | Pipelines[3] | Tankers[3] | Total Num. | Total Prob. | Num. | Prob. | Num. | Prob. |
| N. Atlantic | 49 | 0.30 | P+T4 | 0.05 | 0.08 | 0.03 | 0.16 | 0.15 | -- | -- | 0.16 | 0.15 |
| Mid-Atlantic | 25 | 1.00 | P+T4 | 0.02 | 0.04 | 0.03 | 0.10 | 0.09 | 0.02 | 0.02 | 0.12 | 0.11 |
| S. Atlantic | 69 | 0.25 | P+T4 | 0.07 | 0.11 | 0.04 | 0.22 | 0.20 | -- | -- | 0.22 | 0.20 |
| W. GOM | 437 | 1.00 | 25T75P | 0.44 | 0.52 | 0.14 | 1.10 | 0.67 | 0.20 | 0.18 | 1.30 | 0.73 |
| C. GOM | 1004 | 1.00 | 20T80P | 1.00 | 1.28 | 0.26 | 2.55 | 0.92 | 0.18 | 0.16 | 2.73 | 0.93 |
| E. GOM | 62 | 1.00 | T | 0.06 | -- | 0.04 | 0.10 | 0.10 | -- | -- | 0.10 | 0.10 |
| Wash./Oregon | 58 | 0.20 | T | 0.06 | -- | 0.08 | 0.13 | 0.12 | 0.08 | 0.08 | 0.22 | 0.10* |
| N. Calif | 231 | 0.60 | T | 0.23 | -- | 0.15 | 0.38 | 0.32 | -- | -- | 0.38 | 0.32 |
| C. Calif | 207 | 0.65 | T | 0.21 | -- | 0.27 | 0.48 | 0.38 | 0.27 | 0.23 | 0.74 | 0.44* |
| S. Calif | 462 | 1.00 | 34T66P | 0.46 | 0.49 | 0.20 | 1.15 | 0.68 | 0.23 | 0.21 | 1.39 | 0.75 |
| Gulf of Alaska | 113 | 0.08 | P+T | 0.11 | 0.18 | 0.07 | 0.37 | 0.31 | 0.44 | 0.35 | 0.80 | 0.37* |
| Kodiak | 95 | 0.05 | P+T | 0.10 | 0.15 | 0.06 | 0.31 | 0.26 | -- | -- | 0.31 | 0.26 |
| Cook Inlet | 179 | 0.03 | P+T | 0.18 | 0.29 | 0.12 | 0.58 | 0.44 | -- | -- | 0.58 | 0.44 |
| Shumagin | 48 | 0.03 | P+T | 0.05 | 0.08 | 0.03 | 0.16 | 0.14 | 0.76 | 0.53 | 0.92 | 0.53* |
| N. Aleutian | 173 | 0.20 | P+T[8] | 0.17 | 0.28 | -- | 0.45 | 0.36 | -- | -- | 0.45 | 0.36 |
| St. George | 135 | 0.22 | 50T50P+T[7] | 0.14 | 0.11 | 0.04 | 0.29 | 0.25 | 0.24 | 0.21 | 0.53 | 0.27* |
| Navarin | 1920 | 0.27 | P+T+T[6] | 1.92 | 3.07 | 0.38 | 5.38 | 0.99+ | -- | -- | 5.38 | 0.99+ |
| Norton | 102 | 0.15 | P+T+T[6] | 0.10 | 0.16 | 0.02 | 0.29 | 0.25 | -- | -- | 0.29 | 0.25 |
| Hope | 145 | 0.02 | P+T[5] | 0.14 | 0.23 | -- | 0.38 | 0.31 | -- | -- | 0.38 | 0.31 |
| Chukchi Sea | 1152 | 0.20 | P+T[5] | 1.15 | 1.84 | -- | 3.00 | 0.95 | -- | -- | 3.00 | 0.95 |
| Beaufort | 627 | 0.70 | P+T[5] | 0.63 | 1.00 | -- | 1.63 | 0.80 | -- | -- | 1.63 | 0.80 |
| Straits of FL | 21 | 0.11 | T | 0.02 | -- | 0.03 | 0.05 | 0.05 | -- | -- | 0.05 | 0.05* |

## Table IV.A.4.a.5

## Alternative 4 - Biennial Sales In Areas That Have Triennial Sales in the Proposal

## Estimated Number of Oil Spills Greater Than 1,000 Barrels and Probability of One or More Spills[1]

| Planning Areas | Conditional Oil Resources | | Transportation Modes[2] | Spills from OCS Activities Within Planning Areas | | | | | Spills between Planning Areas | | Total Spills from Proposal in Each Area | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Millions of barrels | MPHC | | Platforms[3] | Pipelines[3] | Tankers[3] | Total Num. | Total Prob. | Num. | Prob. | Num. | Prob. |
| N. Atlantic | 49 | 0.30 | P+T4 | 0.05 | 0.08 | 0.03 | 0.16 | 0.15 | -- | -- | 0.16 | 0.15 |
| Mid-Atlantic | 47 | 1.00 | P+T4 | 0.05 | 0.08 | 0.06 | 0.18 | 0.17 | 0.03 | 0.03 | 0.21 | 0.19 |
| S. Atlantic | 138 | 0.25 | P+T4 | 0.14 | 0.22 | 0.09 | 0.45 | 0.36 | -- | -- | 0.45 | 0.36 |
| W. GOM | 437 | 1.00 | 25T75P | 0.44 | 0.52 | 0.14 | 1.10 | 0.67 | 0.23 | 0.20 | 1.34 | 0.74 |
| C. GOM | 1004 | 1.00 | 20T80P | 1.00 | 1.28 | 0.26 | 2.55 | 0.92 | 0.21 | 0.19 | 2.76 | 0.94 |
| E. GOM | 86 | 1.00 | T | 0.09 | -- | 0.06 | 0.14 | 0.13 | -- | -- | 0.14 | 0.13 |
| Wash./Oregon | 58 | 0.20 | T | 0.06 | -- | 0.08 | 0.13 | 0.12 | 0.09 | 0.09 | 0.23 | 0.11* |
| N. Calif | 231 | 0.60 | T | 0.23 | -- | 0.15 | 0.38 | 0.32 | -- | -- | 0.38 | 0.32 |
| C. Calif | 297 | 0.65 | T | 0.30 | -- | 0.39 | 0.68 | 0.49 | 0.29 | 0.25 | 0.97 | 0.52* |
| S. Calif | 524 | 1.00 | 34T66P | 0.52 | 0.55 | 0.23 | 1.31 | 0.73 | 0.23 | 0.21 | 1.54 | 0.78 |
| Gulf of Alaska | 113 | 0.08 | P+T | 0.11 | 0.18 | 0.07 | 0.37 | 0.31 | 0.50 | 0.38 | 1.38 | 0.41* |
| Kodiak | 95 | 0.05 | P+T | 0.10 | 0.15 | 0.06 | 0.31 | 0.26 | -- | -- | 0.31 | 0.26 |
| Cook Inlet | 179 | 0.03 | P+T | 0.18 | 0.29 | 0.12 | 0.58 | 0.44 | -- | -- | 0.58 | 0.44 |
| Shumagin | 48 | 0.03 | P+T | 0.05 | 0.08 | 0.03 | 0.16 | 0.14 | 0.88 | 0.59 | 1.04 | 0.59* |
| N. Aleutian | 180 | 0.20 | P+T[3] | 0.18 | 0.29 | -- | 0.47 | 0.37 | -- | -- | 0.47 | 0.37 |
| St. George | 270 | 0.22 | 50T50P+T[7] | 0.27 | 0.22 | 0.09 | 0.57 | 0.44 | 0.27 | 0.25 | 0.85 | 0.33* |
| Navarin | 2208 | 0.27 | P+T+T[6] | 2.21 | 3.53 | 0.44 | 6.18 | 0.99+ | -- | -- | 6.18 | 0.99+ |
| Norton | 122 | 0.15 | P+T+T[6] | 0.12 | 0.20 | 0.02 | 0.34 | 0.29 | -- | -- | 0.34 | 0.29 |
| Hope | 145 | 0.02 | P+T[5] | 0.14 | 0.23 | -- | 0.38 | 0.31 | -- | -- | 0.38 | 0.31 |
| Chukchi Sea | 1501 | 0.20 | P+T[5] | 1.50 | 2.40 | -- | 3.90 | 0.98 | -- | -- | 3.90 | 0.98 |
| Beaufort | 666 | 0.70 | P+T[5] | 0.67 | 1.06 | -- | 1.73 | 0.82 | -- | -- | 1.73 | 0.82 |
| Straits of FL | -- | -- | T | -- | -- | -- | -- | -- | -- | -- | -- | -- |

Table IV.A.4.a.6
Alternative 5 - Acceleration of Leasing in Areas That Have Triennial Sale in the Proposal
Estimated Number of Oil Spills Greater Than 1,000 Barrels and Probability of One or More Spills[1]

| lanning Areas | Conditional Oil Resources | | Transportation Modes[2] | Spills from OCS Activities Within Planning Areas | | | | | Spills between Planning Areas | | Total Spills from Proposal in Each Area | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Millions of barrels | MPHC | | Platforms[3] | Pipelines[3] | Tankers[3] | Total Num. | Total Prob. | Num. | Prob. | Num. | Prob. |
| . Atlantic | 49 | 0.30 | P+T4 | 0.05 | 0.08 | 0.03 | 0.16 | 0.15 | -- | -- | 0.16 | 0.15 |
| id-Atlantic | 25 | 1.00 | P+T4 | 0.02 | 0.04 | 0.03 | 0.10 | 0.09 | 0.02 | 0.02 | 0.12 | 0.11 |
| . Atlantic | 69 | 0.25 | P+T4 | 0.07 | 0.11 | 0.04 | 0.22 | 0.20 | -- | -- | 0.22 | 0.20 |
| . GOM | 437 | 1.00 | 25T75P | 0.44 | 0.52 | 0.14 | 1.10 | 0.67 | 0.20 | 0.18 | 1.30 | 0.73 |
| . GOM | 1004 | 1.00 | 20T80P | 1.00 | 1.28 | 0.26 | 2.55 | 0.92 | 0.18 | 0.16 | 2.73 | 0.93 |
| . GOM | 62 | 1.00 | T | 0.06 | -- | 0.04 | 0.10 | 0.10 | -- | -- | 0.10 | 0.10 |
| ash./Oregon | 58 | 0.20 | T | 0.06 | -- | 0.08 | 0.13 | 0.12 | 0.08 | 0.08 | 0.22 | 0.10* |
| . Calif | 231 | 0.60 | T | 0.23 | -- | 0.15 | 0.38 | 0.32 | -- | -- | 0.38 | 0.32 |
| . Calif | 207 | 0.65 | T | 0.21 | -- | 0.27 | 0.48 | 0.38 | 0.27 | 0.23 | 0.74 | 0.44* |
| . Calif | 400 | 1.00 | 34T66P | 0.40 | 0.42 | 0.18 | 1.00 | 0.63 | 0.23 | 0.21 | 1.23 | 0.71 |
| ulf of Alaska | 113 | 0.08 | P+T | 0.11 | 0.18 | 0.07 | 0.37 | 0.31 | 0.44 | 0.35 | 0.80 | 0.37* |
| odiak | 95 | 0.05 | P+T | 0.10 | 0.15 | 0.06 | 0.31 | 0.26 | -- | -- | 0.31 | 0.26 |
| ook Inlet | 179 | 0.03 | P+T | 0.18 | 0.29 | 0.12 | 0.58 | 0.44 | -- | -- | 0.58 | 0.44 |
| humagin | 48 | 0.03 | P+T | 0.05 | 0.08 | 0.03 | 0.16 | 0.14 | 0.76 | 0.53 | 0.91 | 0.53* |
| . Aleutian | 173 | 0.20 | P+T[8] | 0.17 | 0.28 | -- | 0.45 | 0.36 | -- | -- | 0.45 | 0.36 |
| t. George | 135 | 0.22 | 50T50P+T[7] | 0.14 | 0.11 | 0.04 | 0.29 | 0.25 | 0.24 | 0.21 | 0.53 | 0.27* |
| avarin | 1920 | 0.27 | P+T+T[6] | 1.92 | 3.07 | 0.38 | 5.38 | 0.99+ | -- | -- | 5.38 | 0.99+ |
| orton | 102 | 0.15 | P+T+T[6] | 0.10 | 0.16 | 0.02 | 0.29 | 0.25 | -- | -- | 0.29 | 0.25 |
| ope | 145 | 0.02 | P+T[5] | 0.14 | 0.23 | -- | 0.38 | 0.31 | -- | -- | 0.38 | 0.31 |
| hukchi Sea | 1152 | 0.20 | P+T[5] | 1.15 | 1.84 | -- | 3.00 | 0.95 | -- | -- | 3.00 | 0.95 |
| eaufort | 627 | 0.70 | P+T[5] | 0.63 | 1.00 | -- | 1.63 | 0.80 | -- | -- | 1.63 | 0.80 |
| traits of FL | -- | -- | T | -- | -- | -- | -- | -- | -- | -- | -- | -- |

table IV.A.4.a.4 is for Alternative III, Add a Sale in the Stratis of Florida. Table IV.A.4.a.5 is the results for Alternative IV biennial sales; and table IV.A.4.a.6 is the results for Alternative V, acceleration provision. The footnotes for these tables explain how the calculations were made.

All five tables have essentially the same format. The planning areas are listed down the left side. The conditional oil resource estimates and the marginal probability of hydrocarbons are provided in column one, and the rest of the table presents the results of the model runs. The group of columns headed "Spills from OCS Activities Within Planning Areas" present the estimated number of spills (greater than 1,000 barrels) expected within each planning area from development and transportation of the conditional oil resource estimates for each planning area. The columns headed "Spills between Planning Areas" provide the results for the estimated number of spills expected from the transportation of the production expected under the alternative into each planning area. For example, virtually all Alaskan OCS oil will be tankered to refineries located along the West and Gulf Coasts. The estimated number of oil spills (greater than 1,000 barrels) attendent to this transportation between planning areas is shown in these columns. Table IV.A.4.a.2, the cumulative impacts case, provides two additional estimates concerning numbers of oil spills. The column "Other Domestic" reports the results of running the model on the estimated volumes of domestic oil, other than OCS oil, expected to move via tanker and barge between U.S. ports over a 30-year period (1987-2017). The columns headed "Imports" provide the model results when the expected volume of imports over the same 30-year period are distributed between planning areas using historical average percentages of imports by planning area. All data concerning estimated future domestic non-OCS oil production and imports were provided by the Department of Energy.

Footnotes for tables IV A.4.a.1-6

1. Oil spills greater than 1,000 barrels are considered to be governed by a Poisson process (Smith, and others, 1982, Lanfear and Amstutz, 1983); thus the probability of a specific number of spills (P(n)) occurring is described by the Poisson distribution: $P(n) = e^{-a} a^n/n!$, where n is the specific number of spills (0, 1, 2, ..., n), e is the base of natural logarithms and a is the mean of the Poisson distribution. The probability of one or more spills is calculated as 1 - P(0) or simply $1 - e^{-a}$.

The probabilities for one or more spills associated with the total number of spills expected in each planning area is calculated as $1-e^{-a}$, where -a is the sum of the means for each source of spills. This calculation assumes independence between spills from the various sources of spills, e.g., platforms and tankers.

2. The transportation mode symbols have the following meanings: T, 100 percent tanker; P, 100 percent pipeline; 25T75P, 25 percent tanker, 75 percent pipeline; P + T, 100 percent pipeline followed by 100 percent tanker; T + T, 100 percent tanker followed by another 100 percent tanker;

and 50T50P + T, 50 percent tanker, 50 percent pipeline followed by 100 percent tanker.

3. The mean spill rates used in these table are expressed as the number of spills per billion barrels produced or transported. The appropriate mean spill rates were reported by Lanfear and Amstutz (1983)

| Source | Mean spill rate for spills greater than 1,000 barrels |
|---|---|
| Platforms | 1.0 |
| Pipeline | 1.6 |
| Tankers at Sea | 0.9 |
| Tankers in Port | 0.4 |

4. All oil produced in the North and South Atlantic Planning Areas will be shipped to refineries in the Mid-Atlantic Planning Area. Therefore, one-half of the 1.3 spills/billion barrels is allocated to the area of production, and one half is allocated to the Mid-Atlantic Planning Area.

5. All oil from the Beaufort, Chukchi and Hope Planning Areas will be pipelined to shore, use the TransAlaska pipeline and then tanker shipment out of the Gulf of Alaska Planning Area. One-half of the 1.3 spills/billion barrels for tankers is assigned to the Gulf of Alaska Planning Area and the other one-half is assigned to the planning area that receives the tanker shipment. Risked resource estimates are the basis for calculating the volumes used in these between area spillage.

6. All oil from the Norton and Navarin Planning Areas will be transported by ice breaking tankers to the Shumagin Planning Area where it will be offloaded and loaded onto tankers for shipment to the lower 48. One-half of the expected spillage from the ice breaking leg is assigned to Shumagin as is one-half of the expected spillage from the tanker leg to the lower 48. The other half of the expected spillage during the ice breaking tanker leg is assigned as follows: 0.20 spills/billion barrels to area of production (half in port spills) and 0.45 spills/billion barrels (one-half of the at sea spills) to St. George.

7. One-half of the oil from St. George will be loaded onto tankers for shipment to the lower 48. One-half of the 1.3 spills/billion barrels for this tanker shipment is assigned to St. George and the other one-half to the planning area that receives the oil. The other one-half of St. George oil will be pipelined to Shumagin where it will be loaded onto tankers for shipment to the lower 48. Pipeline spillage is assigned to St. George, and one-half of the tanker spillage is assigned to Shumagin with the planning areas that receive the oil having the other half of the expected tanker spillage.

8. All oil from the North Aleutian Planning Area will move via pipeline to Shumagin where it will be loaded onto tankers for shipment to the lower 48.

*The total spills from proposal in each planning area were calculated as the sum of the total spills within each planning area and the spills from transportation between planning areas. The spills within each planning area are based on the conditional resource estimates while the spills from transportation between planning areas are based on risked resource estimates. Adding these spill frequencies together requires an assumption of a marginal probability of hydrocarbons MPHC equal to one for each planning area that receives oil shipped from other planning areas. These assumptions are not correct for several planning areas where the MPHC is less than one, the probability of one or more spills was calculated using the MPHC for the area and they were noted with a (*).

### b. Oil Spill Cleanup and Containment

Minimizing potentially negative impacts to the environment from offshore oil spills has been a prime concern of government and industry for many years. As a result, stricter environmental operating regulations have evolved, oil spill cleanup devices have been developed and improved, and research efforts continue for more efficient cleanup techniques.

The regulations addressing cleanup include the U.S. Department of the Interior MMS OCS Orders governing oil and gas lease operations (January 1980). Order Numbers 2, 5, and 7 specifically address blow-out preventors, pollution-prevention equipment, oil spill contingency planning, personnel training requirements, and cleanup equipment. In addition to these operating Orders, a Memorandum-of-Understanding (MOU) Commandant Notice No. 5740 between the U.S. Coast Guard (USCG) (the lead agency predesignated as on-scene coordinators (OSC) for OCS oil spills) and the U.S. Geological Survey (USCG) (now the MMS) specifically lists guidelines for contingency planning and cleanup ability requirements. Requirements for spill response capabilities apply to operators of both exploration and development rigs. These requirements have resulted in the ability to handle most minor spills, a significant capability in addition to the cleanup cooperatives. Both the USCG and MMS review serious accidents and take corrective actions to prevent recurrence.

A wide variety of equipment is available to aid in the containment and cleanup of spilled oil. Current designs allow for cleanup operations at various stages of the spill. In some situations, however, it has been proven beneficial to use manual cleanup as opposed to mechanical equipment. Containment and cleanup operations have and always will be labor intensive operations due merely to the complexity of the environment they are conducted in and the constant monitoring/planning efforts associated with these types of operations. Personnel must be well-trained in the use of equipment and the methodology of spill containment and cleanup.

The most common products used for oil spill control and containment are booms, skimmers, sorbents, spill control chemicals, and pumps. Generally, booms are: (1) floating barriers that are constructed in such a manner as to have significant freeboard and draft and are packaged compactly to allow for ease of transportation and deployment; (2) used to contain spilled oil for recovery, divert oil to areas where recovery is easily carried out, and used as a barrier in pathways to areas containing commercially valuable or environmentally sensitive resources; and (3) constructed of modern lightweight/high-impact materials (high strength to weight ratio), with a draft of 0.3-1.5 m, freeboard of 0.2-0.8 m, towing speeds to 15 kts, and sweeping speeds to 3 kts.

Skimmers are devices designed to remove a layer of oil from the water's surface for disposal. Most skimmers can be classified as weir skimmers (provides gravity drain off of oil), centrifugal skimmers (where a power source is used to create a vortex that drains the oil into collection tanks), submission skimmers (utilized by vessel by forcing the oil below the water level and using its buoyant property in the collection process), and eleophylic skimmers (collects oil on a moving sorbent material and mechanically squeezes it into collection areas). Skimmers typically have a recovery rate of up to 300 tons/hour, a skimming speed of approximately 1.5 kts, operable in a sea up to a maximum of 2-3 m and a recovery efficiency of around 80-90percent in optimum conditions.

Sorbents are those materials that recover oil either by absorbing on the material's surface or absorbing into the material's pores. Sorbents can generally be classed as natural organic material (cellulous, peat, or straw), synthetic organic substances (polyurethane, polystyrene, and rubber), and mineral-based compounds (ash, vermiculite and perlite). They are also available in various sizes and shapes for particular requirements and are available in rolls, sheets, particulate, pillows, and booms.

Pumps are used in oil spill cleanup operations to transfer oil from a collecting device to a vessel or facility for separation, reprocessing storage, or transportation to other facilities, and are considered necessary equipment for cleanup activities.

A large number of these cleanup devices are available commercially. However, because of the high cost of specialty equipment and infrequent use, this equipment is not normally stockpiled in quantity by many companies and Federal Agencies. It is selectively stockpiled in strategic locations by the USCG and oil spill recovery companies, and in smaller amounts by other companies and organizations.

The use of chemical agents to facilitate oil spill cleanups is presently discouraged; however, when mechanical cleanup is not feasible due to weather conditions or other reasons, chemical dispersants may be applied either from the air or surface ships. As specified in the National Oil and Hazardous Substance Contingency Plan (NCP), the OSC are authorized to use dispersants in oil spill cleanups, but only if these dispersants appear on the dispersant acceptance list. This dispersant acceptance list includes 28 products tested and accepted under procedures described in the 1981 NCP. Concurrence of the U.S. Environmental Protection EPA representative to the Regional Response Team (RRT) and the concurrence of the States with jurisdiction over the navigable waters polluted by the oil discharge is needed to authorize the use of dispersants, surface collecting agents, and biological additives on the oil discharge, provided that the dispersants, surface collecting agents, or additives are on the NCP Product Schedule. However, the OSC may use a product not on the NCP Product Schedule without obtaining the concurrence of the EPA representative to the RRT of the States when, in the judgment of the OSC, the use of the product is neces-sary to prevent or substantially reduce a hazard to human life. Afterwards, the OSC is to inform the USEPA RRT representative and the affected States of the use of a product as soon as possible to obtain their concurrence for its continued use once the threat to human life has subsided.

A significant distinction between using chemical dispersants and conventional mechanical cleanup techniques to deal with an oil spill is that dispersants do not actually remove the oil from the environment, but rather act to break up slicks, allowing a faster/greater dilution by wind and ocean currents, and increased biodegradation, sinking, and evaporation. Dispersants therefore represent an environmental tradeoff. For example, by preventing oil from contacting a sensitive sea lion pupping area but allowing the oil to disperse through the water column, therefore, immediate impacts to a high valve resource are avoided, and lower and dispersed impact to zooplankton is accepted. The environmental/ecological damage may be changed, though not entirely eliminated.

EPA is considering streamlining the approval process. A multidisciplinary task force (industry, government, and academia) is currently developing ecologically based guidelines for dispersant use, with the intention of minimizing ecological damage from oil spills. Dispersants are being considered on an equal level with other cleanup alternatives, including the "no action" option. A final report and new policy are expected within the year.

The State of Florida has recently signed an agreement with the USCG and the EPA on the use of dispersants. This agreement allows the predesignated USCG on-scene coordinator to have pre-approval to use dispersants on oil discharges. The USEPA and the State of Florida agree with the USCG that the decision to use dispersants or chemicals rests solely with the predesignated USCG OSC, and that no further approval, concurrence, or consultation on the part of the USCG or the USCG OSC with the EPA or the State of Florida is required. This agreement does, however, prohibit the use of dispersants or other chemicals over biologically sensitive areas designated outstanding Florida waters, coastal marshes, or waters in mangrove forests, except with the prior and express authorization of the State of Florida and the EPA. In addition, this approval is required in nearshore areas where recreational economic/aesthetic value versus the environmental concerns cannot be made.

In California the oil companies have pooled their resources by forming oil spill cleanup cooperatives. There are currently two such co-ops in Southern California: Clean Seas in the Santa Barbara Channel (and Santa Maria Basin area), and Clean Coastal Waters in the San Pedro/Long Beach area. Additional cleanup capabilities are found at the four other co-ops on the West Coast, the Coast Guard Pacific Strike Team located in San Rafael, and other Coast Guard facilities, which would all be accessed in the event additional assistance is required (all available equipment and personnel from around the country would be made available in the event of a catastrophic spill). The co-ops are on 24-hour call and have several vessels dedicated for cleanup operations. The co-ops have prestaged equipment vans at strategic locations. In addition, they have permanently installed anchor rings to the jettys at the entrance to Newport Harbor and other locations for fast boom deployment to prevent oil from entering. The co-ops also have established plans and equipment for protecting specific creeks and estuaries from oil spills.

The oil spill co-ops will expand their operating budgets proportionately, as increased offshore oil activity requires additional equipment and personnel to maintain an adequate level of protection and preparedness. The co-ops are constantly evaluating and purchasing new equipment, as the oil spill cleanup industry is rapidly changing.

In Alaska the industry oil spill response organization, Alaska Clean Seas (ACS), was organized by the petroleum industry for its activities in the Bering Sea. The ACS organization is divided into Cost Participating Areas (CPA's). The current areas are the ABSORB CPA (Beaufort Sea) and the Norton Gulf of Alaska Cleanup Organization. It is anticipated that a separate North Aleutian Basin CPA will be formed as required. This cleanup organization and others (such as CIRO) operate through a voluntary private industry agreement to jointly acquire oil spill containment and cleanup equipment, to train personnel in its use, and to provide a pooled capability of response greater than any one company could provide.

To implement the Clean Water Act (1973), as amended, the President's Council on Environmental Quality (CEQ) developed the NCP. It follows specific legislative direction to include: (1) the duties and responsibilities of each Federal Agency in coordination with State and local agencies; (2) a strike force of trained personnel available to provide the earliest possible alert to a discharge; (3) a system of surveillance to provide the earliest possible notice of discharge; (4) a national center to coordinate the plan; and (5) procedures and techniques for identifying, containing, and removing the discharge or dispersing it, if necessary.

In addition, the CEQ requires a detailed oil spill contingency plan for every exploration and development plan submitted. This plan shall include emergency procedures and contact personnel, documentation of environmental areas to be protected, actual plans to follow in the event of a spill, containment and cleanup measures, and oil spill response training requirements.

The EPA and USCG are the enforcing Agencies for the Clean Water Act. These agencies have the authority and the capacity to marshal the Nation's capabilities to combat oil spills.

As part of any OCS lease, MMS OCS Order No. 7 requires the lessee to submit an Oil Spill Contingency Plan for approval by the Deputy Conservation Manager (DCM), Offshore Operations Support, with or prior to submitting an Exploration Plan or a Development and Production Plan. Oil Spill Contingency Plans which do not conform to requirements must be modified as required and resubmitted for approval. These plans are reviewed annually. Plans must include the identification and location of equipment, committed and uncommitted, and the time required for deployment;

the provisions for varying degrees of response efforts based on the severity of an oil spill; and the procedures for the purpose of early detection and timely notification of an oil spill including a current list of names, telephone numbers, and addresses of the persons, organizations, and agencies to be contacted.

### c. Impacts on Biological Resources

Petroleum hydrocarbons may have short-term acute and long-term chronic effects on marine organisms. The short-term acute effects are usually associated with accidental oil spills and the immediate aftermath. Long-term chronic effects may be associated with the time period following an oil spill during which biological populations and habitats attempt to recover. Short-term acute effects are usually measured by death of the organisms either in the laboratory in 96-hour bioassays or in the field by censusing dead animals and plants. Long-term chronic effects are usually measured by changes in the natural animal and plant communities affected by oil and the length of time in which the community gradually returns to the pre-oiling status.

Many factors affect the behavior of spilled oil in the ocean and its effects on marine life. Temperature, wave conditions, sediment absorption, etc., combine with biological factors such as age, reproductive maturity, and physiological condition of the organisms to determine the impact of oil on biological communities in the ocean.

The uptake and effects of crude oil and components of crude oil have been extensively investigated during the last decade. The reader is referred to Anderson (1975); Malins (1977); Wolfe (1977); Neff (1979); Neff and Anderson (1981); AIBS (1976); Olla et al. (1980); Malins and Hodgins (1981); Rice (1981); OMPA (1981); ERCO (1982); Malins et al. (1982); and OMPA (1982) for in-depth reviews of much of the research.

The acute toxicity concentrations of petroleum hydrocarbons range from about one (1) part per million (ppm) to over 100,000 ppm for a variety of adult organisms (Craddock, 1977). Larval forms of many organisms are more sensitive with toxicity levels of 8-12 parts per billion (ppb) for shrimp in 4-day toxicity bioassays (Sanborn and Malins, 1977). Sublethal exposures to petroleum hydrocarbons have resulted in delays in development and growth in larval crabs (Johns and Pechenik, 1980) and larval fish (MMS Study Contract No. AA851-CT074, unpublished). The latter study demonstrated statistically significant reductions in growth in larval northern anchovy, Engraulis mordax, when exposed to concentrations of 5 ppb WSF (water soluble fraction) Santa Barbara crude oil for 14 days in the laboratory.

Extensive reviews of the effects of petroleum hydrocarbons on planktonic and benthic organisms have been provided by Johnson (1977) and Environmental Sciences Limited (ESL, 1982). Further, the observations of effects on planktonic and benthic communities following several major spills has been reviewed and summarized by Duval et al. (1981). These reviews indicate that a variety of responses in these communities are possible as a result of oil spills.

Phytoplankton community responses range from stimulated growth to marked reductions in primary productivity and associated changes in species compostion. Effects on zooplankton also vary from lethal to no effect.

Petroleum hydrocarbons have been shown to have narcotizing effects in arthropods such as planktonic larval lobsters (Donahue et al., 1977) and grass shrimp (Tatem, 1976). Narcosis also seems to be a general response to hydrocarbons by mollusks such as the limpet Patella vulgata which loses its ability to maintain attachment to the substrate (Dicks, 1973) and the snail Thais lamallosa in which response to tactile stimulation is lost (Ehrsam et al., 1972).

Behavioral changes have been noted in invertebrates and vertebrates exposed to petroleum hydrocarbons. Reductions in the feeding behavior in the starfish Asterias vulgaris (Whittle and Blumer, 1970), increased crawling rate in the snail Littorina littorea (Hargrave and Newcombe, 1973), and avoidance and cough reactions in fish (Syazuki, 1964; Rice et al., 1977) have been noted.

It is generally agreed that the most vulnerable or sensitive stages in fish or shellfish life histories to containment exposure or environmental stress are those associated with gonadal development, early embryos, and larval stages (Rosenthal and Alderdice, 1976). Larval forms are especially vulnerable when the yolk sac has been fully absorbed and they must actively search and find prey. Eggs and larvae have been the focus of many studies on fish and invertebrate species because both groups have at least one planktonic life stage. At this time, the eggs and/or larvae are largely free-floating or relatively immobile and are unable to protect themselves from changes in their surroundings such as environmental perturbations and predation. A synthesis of results of existing bioassays indicates the following relative sensitivities for various ecological groups to the WSF of petroleum hydrocarbons.

Effects of petroleum hydrocarbons on reproduction have been shown in the laboratory. Tatem (1976) found reduced hatching rate in grass shrimp exposed to No. 2 fuel oil for 72 hours, and Struhsaker et al., (1974) found reduced survival of eggs and larvae in the Pacific herring and northern anchovy.

Birds which spend much time on the sea surface (e.g., shearwaters, cormorants, seaducks, and alcids) are especially vulnerable to oil spills (King and Sanger, 1979). Mortality results primarily from hypothermia (excessive heat loss) as oil mats the plumage destroying the thermal barrier (air trapped beneath the feathers). Direct contact by birds with oil of appreciable amounts is usually fatal.

Abnormalities in bird reproductive physiology and behavior resulting from ingestion of oil (Hartung and Hunt, 1966; Patten and Patten, 1977; Stickel and Dieter, 1979; Ainley et al., 1981; Holmes, 1981; Peakall et al., 1981; and Gorsline and Holmes, 1982) potentially could have substantial adverse effects on egg production in seabird and waterfowl populations. In addition, transfer of oil from adults to eggs results in reduced hatchability, increased incidence of deformities, and reduced growth rates in young (Grau et al., 1977; Albers, 1978; Szaro et al., 1978; Patten and Patten, 1979; and Stickel and Dieter, 1979). Holmes et al. (1978) have shown that stress from ingested oil can be additive to ordinary environmental stress (e.g., low temperature). Presumably, the effects of external oiling would also be more severe when birds are under environmental stress (e.g., winter) or physiological stress (e.g., molting).

Effects of oil on marine mammals reported in the literature are reviewed by Geraci and St. Aubin (1980). Adult hair seals, walrus, and sea lions, whose insulation is provided by a thick layer of blubber, apparently suffer no serious thermal effects (hypothermia) from pelage oiling (Kooyman et al., 1976, 1977; and Geraci and Smith, 1977). However, pelage degradation and subsequent wetting has been shown to result in hypothermia in hair seal pups, sea otters, northern fur seals, and polar bears which lack a thick fat layer. The increased metabolic costs following contact with oil, when added to other stresses such as pregnancy, lactation, fasting, molting, food shortages, sickness, or severe weather, could have severe effects upon the health of individual of these fur-insulated species and could result in the death of individuals.

Based on the laboratory research (Geraci and St. Aubin, 1983; Goodale, Byman and Winn, 1979; and Gruber, 1981), the most likely effects of oil on endangered whales are: (1) a mild deleterious but reversible effect on the skin; (2) possible eye irritation, which would be reversible unless exposure was prolonged; (3) possible short-term baleen fouling with possible feeding reduction for 1 or 2 days; (4) possible blowhole fouling and death due to respiratory stress for very young animals in heavy oil; and (5) temporary food reducton or contamination, and oil ingestion by gray whales. Potential but unlikely effects include: (1) possible mortality due to respiratory stress; (2) possible mortality to young or already stressed animals immediately after a spill, due to ingestion of oil or inhalation of vapors; and (3) possible mortality due to stress if individuals are already stressed. Mortality has not been verified for any cetaceans due to an oil spill. Therefore, it must assumed that, if deaths occurred, the percentage would be very low, except under unusual circumstances.

Sublethal effects of oil sediments have been demonstrated. Roesijadi and Anderson (1979) found that Macoma inquinata exhibited reduced condition index and levels of free amino acids when exposed to sediments with 1,200 ppm oil. Similar experiments with the polychaete Abarenicola pacifica have shown reduced feeding and glycogen level at 500 and 1,000 ppm oil in sediments (Augenfield et al., 1982). Vanderhorst et al., (1981) have carried out a 3-year study of experimentally oiled sediment trays in the Straits of Juan de Fuca. They found significant biological effects in recovery rates for the clam Protothaca staminea due to oil. Recovery also depended on substrate type with full recovery of sand substrate oiled with 1,880 ppm at 31 months and full recovery of a commercial clam bed oiled with 2,500 ppm at 46 months.

The potential for biomagnification of petroleum hydrocarbons through the ocean's food webs is an issue of concern raised in regard to offshore oil development. A careful distinction must be made here between biomagnification and bioaccumulation. Biomagnification is a phenomenon in which a material shows increases in concentration within the tissue of organisms as one moves up the food web from producing plants (marine algae) to the highest level carnivores (sharks, fish, marine mammals, and seabirds). The increase in concentrations of the material being biomagnified is primarily caused by organisms feeding on a food source which itself has already concentrated the material from a lower food source or from the surrounding ocean. Bioaccumulation is the phenomenon in which organisms show increased tissue levels of a material with age and in response to levels in the surrounding water or sediments. It is depending more on the individual's ability to take up the material, metabolize the material, and excrete the material than on the organism's position in a food web. A workshop sponsored by the National Academy of Sciences in 1981 on Petroleum in the Marine Environment concluded that to date no evidence for biomagnification of petroleum hydrocarbons existed to but that many organisms had shown the ability to bioaccumulate (and depurate or cleanse themselves of) hydrocarbons.

### d. Fate of Oil in the Marine Environment

A variety of processes occur when oil is spilled on water, altering its chemical and physical characteristics. Collectively, these are referred to as weathering or aging of the oil and will determine, to a large degree, its fate. Spilled crude oil disperses and degrades rapidly under the influences of warm climatic conditions depending upon the properties of the oil. Times for the dominant effects of the weathering processes (a mass balance), as well as the percent volume loss from the slick from the sea surface after 10 and 30 days, are indicated in Table IV.A.4.d.1.

By 4 days, enlargement of the slick is completed, and actual spreading is subordinate to fragmentation and dispersion (Wheeler, 1978). After 10 days, the oil properties have changed extensively. The original volume has decreased greatly; 47-67percent of the original slick volume is lost from the water's surface. The floating oil is largely devoid of its volatile (acutely toxic) components and is gradually forming emulsions.

Dominant processes affecting spilled oil during the 10 days or less include spreading, evaporation, dissolutions, and dispersion. Dominant processes altering a slick's characteristics after 10 days include emulsion formation, sedimentation, auto- and photo-oxidation, biological processes, and tar residue formation (Jordan and Payne, 1980).

When initially spilled, most crude oils float. However, some of the spilled oil is found dispersed and retained in the water column.

About 1-5 percent of the volume of the surface slick is predicted to occur in the water column in the vicinity of the spill. Some of this oil will reach bottom sediments (MacKay, 1979; University of Rhode Island, Department of Ocean Engineering and Graduate School of Oceanography and Applied Science Associates, 1981; and Boehm and Fiest, 1980). The relative amount of oil which resides in the water column is a function of a number of factors, including the chemical and physical nature of the oil, the point of release (surface versus subsurface), and the hydrographic conditions affecting the slick formed, particularly the sea surface turbulence. The location of subsurface oil is governed by the density stratification of the water column. The submerged oil exists in association with strong water temperature and salinity gradients.

Fiest and Boehm (1980) reviewed the literature reporting concentrations of oil in water and found that the average reported concentrations generally were: less than 1 mg/l for pristine areas; 2-100 mg/l under spills occurring in nearshore areas; and 100-800 mg/l in heavily polluted urban environments. General background values for the Gulf of Mexico were nondetectable to 70 mg/l. The higher value indicates a chronic paraffinic oil intrusion.

The concentrations of oil in the water column measured around the site of the IXTOC blowout ranged from values of less than 5 mg/l at a distance of 80 km from the blowout to peak values of 10,600 mg/l within a few hundred meters of the wellhead. The highest concentrations were observed within 25 km of the blowout in the top 6 m of the water column (Fiest and Boehm, 1980). Fiest and Boehm (1980) compared these IXTOC results to other major spills and, except for the very high concentrations beneath the surface slick, found that values measured at the outside edge of the oil plume were similar to the maximum values measured during other major spills (Ekofisk blowout, 2-300 mg/l; Amoco Cadiz, 350 mg/l; and Argo Merchant, 450 mg/l).

The mechanisms which result in oil being retained in the water column include: dissolution, dispersion, sinking, sedimentation, and subsurface plume formation.

### (1) Dissolution

Lower molecular weight hydrocarbons, in particular aromatics such as benzene and toluene that are acutely toxic, will rapidly dissolve into the water column once oil is spilled.

### (2) Dispersion

The agitation of oil slicks due to the breaking of waves and the action of the surf supplies the energy to form small droplets of stable emulsions from 5 micrometers to several millimeters in size. Such droplets are then pushed into the water column and dispersed. Dispersion of a surface slick is an important process in determining the lifetime of the slick. The formation droplets increase the surface area of the oil, thereby increasing the rates of physical, chemical, and biological processes affecting the weathering of the oil.

### (3) Sinking

Whole oil particles in the form of mousse or tar could become heavier than the surrounding water and sink until encountering an interface strong enough to inhibit penetration (Walter and Proni, 1980).

### (4) Sedimentation

This process is characterized by oil associating with particulate material in the water column. In the case of the IXTOC blowout, in several instances, particulates-bound oil was found where surface slicks were not readily apparent (Payne et al., 1980). To explain this, it was hypothesized that once oil had been absorbed onto particulates, it was then subject to subsurface horizontal and vertical advective transport and could be transported a considerable distance before settling to the bottom. Payne et al., (1980), reviewed the literature on particulate/oil interactions and concluded that these interactions are a dominant process in the ultimate disposition of petroleum.

### (5) Subsurface Plume Formation

Fiest and Boehm (1980), Walter and Proni (1980), and others examining the characteristics of the IXTOC blowout occurring in approximately 48 m (157 ft) depth determined that a significant quantity of the oil released at the subsurface from the wellhead formed a subsurface plume of oil droplets suspended in a mixed layer at a depth of 5-20m. The oiled seawater plume moved in response to ocean currents rather than the wind. An oceanic frontal system may have acted as a barrier to the lateral transport of the oil plume and may also have acted as a conduit for the subsurface movement of oil along the frontal axis. Within 5 km from the wellhead, the subsurface plume was made up of oil droplets greater than 0.45 um and had petroleum hydrocarbon concentrations greater than ug/l. Such whole oil was found at concentrations greate. than ug/l. Such whole oil was found at concentrations (greater than 20 ug/l) at 20 m depths within 25 km from the well (Fiest and Boehm, 1980). Although there appeared to be other processes not identified controlling the transport of the subsurface plume from those controlling the movement of the surface slick, the subsurface plume was, for the most part, aligned with the surface slick.

Water samples taken from this subsurface plume were considerably enriched in light aromatics relative to other aromatic components, presumably due to the presence of considerable quantities of soluble, solubilized, or colloidal material in the water. The fact that the subsurface oil can be characterized by a different chemistry and weathering regime implies that the subsurface oil is a "fresh" oil plume which has remained subsurface since its discharge, and in which evaporative loss of aromatics is greatly decreased (Boehm and Fiest, 1980). Of particular importance is the fact that concentrations of some of the more toxic components in the water column in sizeable amounts. The concentrations of individual hydrocarbons in the dissolved fraction (0.01-3 ppb) measured in a study by Boehm and Fiest (1980) on oil in the IXTOC water column appeared to lie below the toxic range, even in the acute impact zone. However, the total concentration of waterborne low molecular weight aromatics (alkyl benzenes and naphthalene compounds) in water fell in the 0.5-500 ppb range, and concentrations of total waterborne oil dispersions were in the 100-10,000 ppb (0.10-10 ppm) range. The researchers report that these values fell well within the range of observable effects on marine organisms.

Each spill is a unique event with a number of factors interacting to determine its effects, and all spills could be potentially harmful. The variability encountered in the literature on environmental effects of oil spills is due to differences in oil components, environmental conditions, and the organisms encountered.

Although unanswered questions will remain on the subject of oil spill impact, some general conclusions about the effects of oil spills can be concluded:

(a) Short-term effects of spilled oil in the marine environment are usually not extensive. The marine environment recovers within a short time if the stress is removed or reduced significantly. Oil spills in some coastal areas, particularly shallow estuarine or wetland environments, could result in long-term (up to 10 years or more) effects to flora and fauna (NAS, 1975).

(b) Seabirds, particularly those which dive, have been the most notorious victims of spills. In addition to mortality of individuals, some bird populations make a slow and uncertain recovery from oil-caused losses because they reproduce few at a time or because residual oil may impair reproduction (NAS, 1975; Mack and King, 1980).

(c) Bottom dwellers have been shown to be susceptible to oil spills (Byrne and Calder, 1977; Tatem et al., 1978; and NAS, 1975). Benthic organisms can become coated with heavy oil and smothered. As filter feeders, they also ingest oil present in water. The most sensitive organisms appear to be small crustaceans or crustaceans larvae (Anderson, 1979). Recent field studies suggest less ecological damage than investigators earlier thought to be benthos associated with offshore oil installations, oil spills, or natural marine oil seepage (Middleditch and Basile, 1980; ERCO, 1982; Ward et al., 1980; and Davis and Spies, 1980).

(d) Adult pelagic fish are, for the most part, able to avoid floating oil in open-water areas by swimming away from the affected region. However, other stages of the fish life cycle are more susceptible to acute biological loss. Fish eggs and larvae are vulnerable to oil damage in the open water environment as they float along. Further, spills reaching nearshore bays and spawning or breeding grounds could cause serious detrimental effects (NAS, 1975).

(e) Phytoplankton and zooplankton, critical components of the marine ecosystem, have demonstrated differing reactions to oil (Wong et al., 1981; Gordon and Prouse, 1973; NAS, 1975; and Casey et al., 1982). Researchers have documented changes in the ecosystem following an oil spill in terms of type of primary and secondary producers. The primary productivity of phytoplankton may be reduced during an oil spill episode. Normal growth is restored after the episode passes. Low concentrations of oil have been shown to stimulate the growth of phytoplankton or to have no effect. Zooplankton populations may increase after a spill either because of their feeding on dead phytoplankton or on oil particles themselves. In an experiment conducted by the University of Texas on the toxicity of various oils to representative species of microalgae, Louisiana crude was not toxic (Parker and Menzel, 1974).

(f) Short-term biological loss occurs from an oil spill by direct kill through coating and asphyxiation, by contact poisoning or incorporation of water-soluble toxic carcinogenic or mutagenic components of oil, or by destruction of the generally more sensitive juvenile forms of organisms or of the food source of higher trophic species and by modification of habitats, delaying or preventing recolonization (Blumer, 1971).

(g) The severity of oil pollution on different organisms in various habitats varies from no effect to responses of avoidance, decreased activity, or physiological stress. Not only do different species react differently, but different life stages of an organism will show different tolerances to petroleum hydrocarbons. What is toxic to one organism may not be toxic to the next. The concentration on hydrocarbons in the marine organisms exposed to oil reflects the various levels of uptake, metabolism, storage, and discharge. In general, benthic algae, zooplankton, benthic invertebrates, and fish can depurate hydrocarbons accumulated after exposure to oil. Bivalves, including clams, oysters, and mussels, do not possess the enzyme system, or detoxification system as it is called, and tend to accumulate hydrocarbons (Lee, 1977).

(h) The threat of ground and surface water contamination caused by oil spills on land is often overlooked in favor of the more obvious and immediate effects to surface vegetation and soil. Many of the barrier island communities throughout the Gulf of Mexico obtain their municipal water supplies from the shallow aquifer systems underlying these islands. Therefore, the threat exists for oil spilled in the Gulf of Mexico to come ashore, percolate through the barrier beach sands, and contaminate an island's water supply. Duffy et al., (1977) investigated the persistence of water-soluble hydrocarbons from crude oil spills on land as a source of groundwater contamination. This was accomplished by means of theoretical modeling, percolation experiments, and the analysis of core samples from various spill sites. Their findings suggested that the water-soluable components of crude oil spilled on land are very persistent and could represent long-term environmental threats to a groundwater supply. They further suggest that damage to water resources from crude oil spills on land can be long-lived even if not widespread and that contamination to a groundwater system by oil may not appear until several decades after a spill has occurred. Once detected, however, the technology exists to locate and recover an undergournd accumulation of spilled petroleum or petroleum products on top of groundwater in an aquifer system, as illustrated in an article by Mathes (1982). The success of the methodologies and recovery strategies used on a petroleum products spill that entered the Mississippi Aquifer around St. Louis, Missouri, is discussed in this article. Therefore, although the probability of such an event occurring in the Gulf does exist, it appears that the technology does exist to recover such a spill, once it has been detected in a a water supply.

(i) There is still little known about the long-term or sublethal effects of oil contamination. Long-term or sublethal effects due to low-level concentrations of oil in the environment would be due to oil entering the environment from many sources. Spills from OCS-related oil operations are just one of the sources.

### 5. Man-made Structures

#### a. Onshore Man-Made Structures

Onshore man-made structures refer to shore and landing facilities or structures that would be needed to support OCS-related oil/gas activities. There would be a need for the following types of onshore structures or facilities according to the assumptions developed for this proposal.

- Oil and gas treating facilities,
- Crude oil storage tanks,
- Supply and crew boat bases,
- Onshore oil/gas pipelines,
- Temporary support bases for onshore and offshore pipeline installation activities,
- Airports (existing) for helicopter support activities

Most of these facilities in OCS-related oil/gas producing areas are already in existence. Refer to Section IV.A.2 for a discussion of development that is hypothesized and expected for the proposal.

Direct, impact-producing agents resulting from these onshore man-made structures include space-use conflicts, air emissions, and temporary beach distribution.

#### b. Offshore Man-made Structures

Significant impact-producing agents related to man-made structures include the following: (1) Oil and gas exploratory, installation, and/or construction activities (all short-term), and (2) presence of offshore structures: platforms, pipelines, Single Anchor Leg Moorings (SALMs), and marine terminals (all long-term presence).

##### (1) Exploratory Activity--Short-Term Presence

Exploratory operations usually involve the use of a drilling rig, support vessels (crew, supply, or tug boats), and helicopters. These operations are typically short-term, lasting approximately four months per well, per site.

Generally, three types of drilling rigs are used for exploratory operations: jack-up rigs, semi-submersible rigs, and drillships.

A typical jack-up rig may be about 200 ft. long, and it is towed onto the drilling site by tug boats. The legs are jacked down to the ocean bottom. The rig remains floating until the legs attain proper placement on the bottom and the rig deck is evaluated about 30 ft above the water level. The primary power on board the rig is furnished by several diesel generators.

A typical semi-submersible drilling unit is a self-propelled 290-ft (90m) drilling rig. The primary equipment on the rig includes eight 30,000 lb (13,500 kg) anchors, two 50-ton cranes, and a 160-ft (49m) derrick. Propulsion for the vessel is furnished by twin propellers, each driven by six 850 hp electric motors.

A typical drillship is a self-propelled 459-ft (140m) vessel. The vessel is moored with an eight point wire line system using eight 30,000 lb (13,600 kg) anchors, or it can be dynamically positioned with thrusters. Each anchor is marked by a welded steel cylindrical anchor buoy, 10.5 ft length x 8 ft diameter. A 142 ft derrick is situated in the center of the vessel with two nearby working cranes.

Direct, impact-producing agents of exploratory operations are as follows: (1) vessel anchorage, (2) drilling process, (3) discharges, and (4) vessel presence, and 5) noise.

Vessel anchorage would affect the organisms inhabiting the ocean bottom, particularly in rocky and mud-clay bottom areas. As anchors are lowered onto the substrate, epifauna, epiflora, and infauna would be crushed, either by the anchor itself or by the anchor chains. When the anchors are removed, they are sometimes dragged toward the drillship, crushing organisms along the way. However the standard method of retrieval is for work or tug boats to pick up the anchors and carry them back to the drill vessel. Anchors have also caused mud mounds, trenches, or scars. Anchors could also affect archaeological resources such as historic shipwrecks or aboriginal sites.

The drilling process itself is a direct, impact-producing agent. A typical well is begun with the drilling or jetting with seawater of a surface hole (usually 30-36 in. diameter) to a depth of 100-350 ft. The materials (drill cuttings) that result from this first several hundred feet are discharged directly to the ocean bottom. Subsequent cuttings are returned to the drill vessel and discharged from there. Surface casing is then cemented to the bottom surface. Progressive sections of the hole are drilled with progressively smaller drill bits. Thus, the actual volume of cuttings that is discharged steadily decreases with increasing well depth. Other discharges to the bottom and water column include drill muds and formation water.

Discharges to the bottom and the water column are discussed in detail in Section IVA.8. of this document. Discharges to the air result from the mechanical operation (diesel engines) of the drilling process. These discharges include SOx, NOx, and particulates. Discharges to the air are discussed in detail in Section IVA.8.c of this document.

Another direct, impact-producing agent of exploratory operations is the presence of the drilling rig itself. Vessel presence may result in any of the following effects: (1) navigational hazards, (2) spatial preclusion of fishing activity, (3) viewshed disruption, and (4) noise.

It should be pointed out here that this activity is only temporary in nature (generally duration is less than 4 months), during exploratory operations.

Vessel presence could result in navigational hazards to other vessels under certain adverse conditions. These adverse conditions include periods of high sea state and periods of reduced visibility (e.g., during fog, rain, etc.). Exploratory operations must comply with applicable MMS operating orders and all USCG safety, navigation, and notification requirements.

Commercial fishing space will be temporarily displaced at any site occupied by a drilling rig. Generally, the spatial reduction of fishing is dependent upon the water depth of the wells and is about twice the area taken by the drilling rig or is within the boundary of the anchor scope radius. Thus, one typical rig could preclude fishing from an area of up to 0.79 sq.mi. or 500 acres.

Activity on and around drilling equipment generates noise both above and below the water sruface. Beneath the water, noise can carry for long distances, masking natural communication sounds between animals, and possibly preventing some species from using large areas around offshore operations.

Vessel presence could result in temporary viewshed degradation within 6-8 miles of shore.

### (2) Development Activity-Platform, and Subsea Pipeline

#### (a) Installation Operations--Short-Term Presence

##### (i) Platforms

Platform installation operations usually involve the use of barges, crew boats, supply boats, tug boats, helicopters, and the platform itself. Platforms are generally fabricated at onshore platform fabrication yards and transported to the offshore site by barge for installation. Platform jackets are launched from a launch barge and lowered to the ocean bottom by controlled flooding. Steel pilings are driven to the desired depth through the jacket legs. The platform is leveled, grouted, and welded in place to each of the piles. Platform raising generally requires a few weeks and the total site installation time is about 6 months.

Direct, impact-producing agents that are associated with platform installation operations are: (1) vessel anchorage, and (2) vessel presence. These input agents are discussed below. Refer to Section IV.A.5. for specific discussions on impacts to a resource. These impact-producing agents are similar to those associated with exploratory operations.

##### (ii) Subsea pipeline installation--short term activity

Installation activities usually involve the use of an installation barge and support vessel (crew, supply, or tug boats). These operations are short-term and usually last less than 10 days. This would vary, depending on the length of pipeline to be installed and weather conditions.

A number of different methods are presently available to install offshore pipelines. Pipelines are initially prepared for installation either at an offshore pipeline lay-site on a pipeline lay barge, or at an offshore facility, then towed to the lay-site by a reel barge, surface tow or bottom tow method.

Direct impact-producing agents that are associated with subsea pipeline installation operations are: (1) vessel anchorage, (2) vessel presence, (3) pipeline burial operations, (4) abandoned buoys, and (5) blasting in rocky area. These impact agents are discussed below. Refer to Section IV.A.5.b. for specific discussions on impacts to a resource.

The potential impacts from vessel anchorage and vessel presence are similar to those associated with exploratory operations. A major difference is as follows: exploratory operations take place at a stationary location (i.e., the well site). The installation activities of subsea pipelines take place over a much greater distance (i.e., the pipeline route). Thus, the potential impacts from vessel anchorage (i.e., anchor scars) or vessel presence would be distributed over a much greater area.

#### (b) Long-term presence of offshore structures--platforms, pipelines, SALMs, subsea wellheads

The previous section concentrated on short-term activities: exploratory, installation, and/or construction operations. This section will deal with the long-term OCS-related oil/gas activities (i.e., lasting for periods of 20 to 40 years). These long-term activities are the actual presence of structures and their associated discharges and emissions. Chronic discharges are treated in Sections IV.A.8.a.; air emissions in Sections IV.A.8.c. Impacts to the offshore structures could result in on oil spill. Once installed, offshore platforms become a quasi-permanent feature of the OCS area.

This long-term presence can potentially lead to various hazards and aids as presented and discussed below (refer to Section IV.B.1.a.(5)(g) for specific discussions on impacts to a resource): (1) navigational hazards; (2) spatial disruption (e.g., preemption of fishing space); (3) navigation aids; (4) artificial habitat for marine organisms (fishes, invertebrates, and seaweeds); and (5) viewshed disruption.

Platform presence could result in navigational hazards to other vessels under certain adverse weather conditions. These adverse conditions include periods of high sea state and periods of reduced visibility (e.g., during fog, rain, etc.).

Commercial trawling space will be displaced at any site occupied by a platform. Platforms may occupy up to 7 acres (up to 3 ha); however, the average platform occupies about 1 acre. This space would not be available for trawling.

The long-term presence of an unburied subsea pipeline on the ocean bottom could cause conflicts with commercial trawling operation. Invertebrates and macrophytes (seaweeds) will settle onto this new substrate rapidly following the platforms installation. These organisms develop quickly and serve as an attractive food source for offshore fish populations.

The long-term presence of an unburied subsea pipeline on the ocean bottom could cause conflicts with commercial trawling operations.

SALMs occupy only a small space on the surface. However, with a tanker tied to a SALM mooring line, the vessel could swing or rotate in a circular direction around the mooring site. The maximal swing distance for a SALM is estimated at about 1,829 ft (600 m).

### 6. Vessel Traffic

#### a. Oil Tankers

These vessels range in size from the general purpose tankers (25,000 to 150,000 dwt (dead weight tons)), to the Ultra Large Crude Carriers (300,000 to over 500,000 dwt). Dead weight tons are defined as the total weight of a tanker when it is immersed to the authorized load depth. A typical 27,000 dwt tanker has a storage capacity of about 200,000 bbls of oil, while a 45,000 dwt tanker can hold about 335,000 bbls of oil (storage capacity depends on the density of the transported oil). A typical 16,500 dwt tanker is 532 ft. in length, with a draft (depth a vessel is immersed in water when afloat) of 31 ft. and a beam (extreme width of the vessel) of 70 ft. A typical 100,000 dwt tanker is 861 ft. long, with a draft of 50 ft. and a beam of 125 ft.

Direct, impact-producing agents that are associated with tankers include additional vessel traffic, accidents, tanker operations, ballast cleaning and oil spills (either from routine operations or catastrophic events). The principal causes of most vessel accidents are groundings, collisions,

The smaller sized tankers (6000-35000 dwt) and the medium-sized tankers (35000-160000 dwt) exhibit the highest casualties per 100 tankers at risk on a worldwide basis. Tanker accidents can lead to massive oil spills. Oil spills from tankers may also occur during tanker operations. According to the National Academy of Sciences (1975), most of the 1 million tons of oil per year that goes into the ocean from tank cleaning operations is due to ships not using certain procedures.

All tankers involved in transporting OCS produced crude oil must conform with all standards established for such vessels, pursuant to the Port and Tanker Safety Act of 1978 (PL95-474). Only U.S. flag vessels, which are regulated by the USCG, can be used to transport OCS crude oil. In the Santa Barbara Channel, Exxon has transfered over 28 million barrels of oil from the OS&T (Platform Hondo) to tankers with only a 1-gallon spill occurring during transfer operations. Tankers (U.S. flag) carrying Alaskan North Slope crude to the West, East, and Gulf Coasts have also shown an excellent record, with no oil spills. The spill rate for tankers is 1.3 large spills (greater than or equal to 1,000 bbls) per billion barrels transported. Problems associated with tankers usually involve carriers of imported crude oil or refined petroleum products. About 98 percent of the Gulf of Mexico OCS crude oil is transported to shore via pipeline.

### b. Supply and Crew Boats

Supply and crew boats are used to service offshore oil/gas activities. Supply boats are typically used to transport drilling equipment, cement, drill muds, oil contaminated mud, cuttings or formation water, food, and other supplies to and from the platform or drill-site. Supply boats require harbor or port facilities such as docks, berthing space, and staging areas (for the storage and loading of equipment and supplies). Crew boats are most typically employed to transport drilling personnel to and from the platform or drill-site. Unlike supply boat requirements, crew boats only require docking and berthing facilities at harbors or ports. Helicopters are generally used to transport personnel to rigs or platforms distant from shore.

Direct impact-producing agents that are associated with supply and crew boats follow. These are explained below.

(1) Additional marine traffic;
(2) Support facility requirements; and
(3) Crew and supply boat engines (air emissions).

Impacts associated with additional marine traffic are the increased possibility of vessel-vessel and vessel-structure incidents. These incidents could lead to oil spills, loss of lives, and loss of equipment. Impacts that are associated with support facility requirements include space-use conflicts between the oil industry and other industries (e.g., commercial fishing, etc.).

Impacts that are associated with crew and supply boat engines are air emissions (fumes, exhaust, etc.) which could potentially degrade the ambient air quality.

## 7. Noise and Other Disturbances

Noise and emissions resulting from OCS development are associated with the operation of offshore platforms, drilling rigs, seismic geophysical surveying, petroleum transfer facilities, onshore processing plants, pump stations, aircraft, and vessels. In addition, construction equipment used during the installation of the various facilities emits various amounts of noise. The degree of noise impact depends upon the emitted sound level and the proximity of the source to schools, hospitals, residences, and recreation areas. The location of the various facilities is not known at this time. Thus, site-specific noise impacts cannot be evaluated here; however, they are considered in future environmental documents when development plans are known.

Machinery noise sources found on drilling and production platforms are, generally, similar to those used for shore-based operations. Special noise attenuated devices are sometimes used offshore to protect workers in their living quarters located on the platforms. Compressors and diesel engines are usually the loudest equipment on a typical platform emitting about 90 dBa at a distance of 15 m (50 ft.). By comparison, a diesel truck under full load also emits about 90 dBa at 15 m. Although other sounds, such as banging of pipes may be more intense, they are of short duration. The possible impact of noise emissions on the biological environment is discussed in subsequent sections. This has a potential to degrade the underwater acoustic environment, and may also adversely affect Naval activities in certain areas.

In a quiet sea with light wind conditions, normal offshore platform operations would be inaudible beyond about 2 miles (assuming ambient background noise level of 40 dBa and attenuation due to sound wave spreading only). In rough seas and weather conditions, the offshore facility would be inaudible beyond about 1/8 of a mile (assuming 70 dBa background). No onshore noise impact is expected from normal operations of OCS platforms since even under low background noise conditions they would not be audible from shore. Onshore noise levels could be slightly increased by vessel, vehicle, and helicopter traffic; however, these increases are generally expected to be small. Gales (1981) points out that in light seas the subsea surface noise propagated by a platform could be detected up to 100 miles away.

Most of the onshore processing and support facilities would necessarily be located in industrially zoned areas (except in Alaska) where noise would have a minimal impact. If adverse noise impacts could result, mitigation measures such as sound barriers (i.e., earthen berms, block walls, etc.) and mufflers could be utilized. The site-specific noise impact of these developments will be considered in future environmental documents when detailed development plans are known.

### a. Aircraft and Vessel Noise

Human activities associated with OCS exploration and development, especially air and vessel traffic near nesting waterfowl and seabirds, could reduce productivity of some species and may cause abandonment of important nesting, feeding, and staging areas. Effects studies in the arctic indicate that arctic tern, black brant, and common eider all show lower nesting success in disturbed areas (Gollup et al., 1972). Schweinsberg (1972) reported that snow geese where particularly sensitive to aircraft disturbance during premigratory staging. The responses of birds to human disturbances are highly variable. These responses depend on the species, the physiological or reproductive state of the birds, distance from the disturbance, type, intensity, and duration of the disturbance; and many other factors. Waterfowl nesting on deltas and islands may also be disturbed by aircraft and vessel traffic, and some disturbance of molting and staging birds is likely to occur. However, effects studies by Ward and Sharp (1973) and Gollup, Goldsberry, and Davis (1972) indicate that long-term displacement or abandonment of important molting and feeding areas due to occasional aircraft disturbance is unlikely.

Aircraft and vessel traffic, and human presence associated with OCS-related oil/gas activities could adversely affect marine mammals which occupy overwintering, breeding, and hauling areas in or near certain proposed sale areas. Most pinnipeds are noted for mass exodus from hauling areas when disturbed by low-flying aircraft or close approach by vessels or humans. A serious result of such stampedes is the separation of mother-pup pairs. Johnson (1977) found that if separation occurred before mother-pup recognition was firmly established in harbor seals, generally within 3 weeks of birth, chances of pup survival was greatly reduced. Stampedes into the water also can result in injury to the young. Repeated disturbances may lead to abandonment of traditional breeding or hauling areas in favor of less suitable sites (Geraci and St. Aubin, 1980).

Short-term responses of whales to accoustical disturbances that have been demonstrated include: flight and startle response; vacating of an area; deflecting of migration routes; and changes in swimming, diving, and respiration characteristices. The degree of responses ranged from those so subtle that statistical analysis was necessary to determine whether or not a change had occurred, to total abandonment of an area for several years and return only when historic ambient noise levels were restored. There are many areas where industrial noise has been ongoing for several years; whales have continued to utilize these areas, to some degree, during their migration cycle. If accoustical distubances persist in critical areas, long-term effects may result. Long-term effects may include: permanent abandonment of some habitats, physical damage to the whale's auditory system, and changes in some portion or timing of their migratory cycle. Areas where long-term effects may be most likely to develop are in habitats where ambient noise levels do not presently include high levels of industrial noises (e.g., summer feeding areas, overwintering areas) or where many whales use a small area intensively (e.g., Unimak Pass, Bering Strait). Habituation may be possible if increases in industrial noise levels proceed at a very slow rate (20 to 40 years).

### b. Dredging

Dredging of new channel and maintenance dredging of existing channels is required to provide safe and efficient navigation conditions for commercial and recreational marine transportation. Channel dredging generates significant amounts of dredged material consisting of the sediment and water mixture excavated from areas dredged. On the basis of volume, dredging is the largest single source of material that is ocean dumped. During 1979, more than 72 million cubic yards of dredged material were deposited in the marine environment (U.S. Dept. of the Army, Corps of Engineers, 1980). Of that total, 68 percent were disposed of in the Gulf of Mexico. The total constituted nearly eight times the combined tonnage of industrial wastes, sewage sludge, construction debris, and other waste material disposed of in the marine environment during 1979 (U.S. Dept. of the Army, Corps of Engineers, 1980). Compared with other materials that are disposed of in the ocean, most of the dredged material excavated in the United States is relatively innocuous, in many instances containing no harmful pollutants and, in most of the remaining cases, containing only trace levels of contaminants. In these cases, the primary concern associated with disposal of the relatively innocuous materials centers around the direct physical effects of disposal. These physical effects include burial of organisms, increased levels of suspended sediments, and accretion of disposed material (U.S. Dept. of the Army, Corps of Engineers, 1978). However, dredged material taken from highly polluted areas is usually contaminated with harmful chemical constituents such as heavy metals, synthetic organics, and oil and grease. Open-ocean disposal of these materials carries the threat of acute or chronic toxic effects on marine organisms and potential contamination of human food resources. Much research has been conducted to describe the effects of dredged material disposal in the marine environment and to evaluate disposal options that may be preferable to ocean dumping.

In general, dredging operations associated with construction projects would result in short-term, localized effects to fish by introducing sediment into the water column and by entraining fish in the suction head of the dredge. This could produce lethal effects through the entrainment, or sublethal responses by inhibiting respiration or feeding activities through increased activity.

In Alaska's Beaufort Sea, artificial gravel islands are used for exploration and production activities. Birds could be temporarily displaced (one year) near island and dredge sites as well as terrestrial gravel storage sites during construction activities. Displacement could occur because of noise disturbance and temporary disruption or removal of food sources near island and dredging sites. Gravel islands would provide additional shoreline habitat and may attract some bird species by providing shelter on the leeward side of the islands. However, human presence may limit bird use of the island, and bird attraction to gravel islands may increase the chances of direct contact between oil spills and birds. Disturbance of birds from dredging and island construction would normally be short-term and disruption of food sources would be local and temporary.

Dredging activities and gravel deposition during island construction could affect marine mammals through noise and disturbance, habitat alterations, and changes in availability of food sources. Noise and disturbance from dredging, island and causeway construction, and support traffic could displace marine mammals within 2 to 3 kilometers of the activity site during operations (USDI-MMS, Proposed Sand and Gravel Lease Sale FEIS, 1983). Dredging and gravel deposition could temporarily disrupt or remove prey species within several kilometers downstream of the dredging site and near the island construction site.

The short-term effects of petroleum industry habitat alteration on endangered whales would include localized temporary reductions in feeding habitats and food resources as a result of dredging, artificial island construction, and the installation of other types of drilling units. There also may be a zone of a few hundred meters of reduced forage around each platform as the result of discharges of drilling fluids; however, this area would be very small in comparison to the available foraging habitat. Once in place, temporary artificial exploration islands would be unlikely to interfere with whale migration or other behavior. The short-term, site-specific increases in turbidity expected from dredging and island construction may not adversely affect endangered whales or habitats within the proposed lease areas. Sediments introduced into the water column by dredging operations associated with artificial island and causeway construction would be less than those which enter naturally during spring breakup (in Alaska) or when storms resuspend bottom sediments (Lowry and Frost, 1981). A long-term change in species composition or abundance of benthic prey items for whales could occur in localized areas as a result of dredging and artificial island construction if substrate characteristics or depth regime were substantially altered. Should these changes occur, however, they would likely be confined to a very small area in comparison to available feeding habitat. It is unlikely that long-term changes in sea ice deformation (in Alaska), currents, water regime, sediment transport, and productivity, or changes in whale migration would result from petroleum industry habitat alteration.

### c. Seismic Operations

Direct, impact-producing agents that are associated with seismic operations are: (1) subsurface impulses; and (2) presence of vesel and associated trailing gear.

Since their beginnings, marine geophysical surveys have caused great concern among commercial fishing and environmental groups. These concerns are that the surveys are lethal, damaging, or disturbing to fish and other marine life and also destructive to commercial fishing gear (crab pots). Because of this, these surveys are regulated by the appropriate State and Federal Agencies with jurisdiction in this area. Additionally, there is information that seismic surveys may conflict physically and spatially with commercial fishing.

Shock waves associated with seismic air guns would not immediately be harmful to marine animals (Geraci and St. Aubin, 1980), although noise may affect behavior. Information concerning responses of marine mammals other than cetaceans to seismic and vessel noise is primarily speculative and anecdotal. The principal evidence is provided by Burns and Kelly (1982) who found no significant difference in ringed seal density along seismic control transects. Other information (ADFG, 1981; Dome Petroleum, 1982) suggests that while seismic and/or vessel noise might temporarily affect hearing, mask vocalizations or sound used to locate prey or predators, or result in temporary displacement if nearby effects on regional population are likely to be minor or negligible.

Whales' reactions to seismic activities vary between immediate response (e.g., flight, startle response) to seemingly no reaction, depending on how close the whales are to an active vessel and what portion of their migration they are in. Behaviors in whales are measured by changes in dive duration, surface duration, numbers of blows per surfacing, travel direction and speed, calling rate, respiration rate, and other dive characteristics.

### d. Drilling/Production

The primary effects of drilling/production activities are tied to the discharge of effluents which is discussed in the following section. Other adverse effects are from support and supply vessels (boats and aircraft). These effects are summarized above.

### 8. Effluents and Discharges

#### a. Water

##### (1) Offshore

Under normal offshore operations, varying degrees of water quality degradation will occur as a result of oil and gas exploration and development activities. Wastes from these activities are varied and may be transformed chemically, biologically, or radioactively when introduced to the marine environment. These wastes may be dissolved and form new substances or be mixed vertically and horizontally in the water column by small-scale motions or large-scale currents, and they may fall into the bottom sediments or be recycled by these same processes. This series of transformations or chemical reactions will govern a waste's transport through the water column and its toxicity to marine organisms. The method of delivery to the environment was well as the intrinsic chemical properties of each source will influence a waste's transport through the water column and its toxicity to marine organisms. The bio-effects may be on individual organisms or whole ecosystems, with long-term effects such as changes in reproductive habits or genetic make-up of species occurring. The method of delivery to the environment as well as the intrinsic chemical properties of each source will influence a waste's distribution in the water column.

Due to the complexity of these waste movements and behaviors, several para--meters are needed to determine their extent of impact. Specification of point source functions, the form of the waste, rate of release, frequency of disposal, and geographical location of disposal are parameters essential in determining the extent of impact on water quality in any given area (Workshop...1979). Also important are the areas affected, the duration of impact, and the period of recovery. Potential water quality degradation resulting from offshore OCS oil and gas operations will be governed by several factors which include the resuspension of bottom sediments through exploration and development activities and pipeline construction; the discharge of drilling fluids and muds; the discharge of formation waters or produced waters; sanitary wastes and domestic wastes; the discharge of deck drainage, and the accidental hydrocarbon discharges due to spill, blowouts, etc.

Impacts resulting from the resuspension of bottom sediments may include increased water turbidities and mobilization of pollutants in the water column as a result of increased dredging activities in nearshore areas containing sediments of highly concentrated pollutants. The magnitude and extent of any turbidity increases will depend on the hydrographic parameters of the area, duration of the activity, and bottom materials composition. Dredging activities in nearshore waters may result in resuspension of settled pollutants, toxic heavy metals, and pesticides, if present. The toxic effects of some of these pollutants could be long lasting in confined areas, depending on the quantities disturbed, local hydrographic effects, and the biota of the immediate area.

### (a) Drill Cuttings and Muds

Once drilling starts, drill cuttings and muds may be discharged into the ocean or they may be barged to onshore disposal sites. Daily discharges of cuttings vary but may range from 0 to 1,700 barrels per day for single exploratory rigs.

Drill cuttings are composed of rock fragments and liquids contained in the geological formation through which the drilling bit is traveling. To remove the drill cuttings, drilling mud (fluid) from the mud system (mud tanks) is circulated down the hole (well) through the drill pipe. Drilling mud is passed out through the drilling bit nozzle, picking up drill cuttings, and returns to the surface between the drill pipe and walls of the bore hole and/or casing. At the surface, drill cuttings are physically separated from the mud by screening and washing techniques. After the drill cuttings and drilling mud are separated, the drill cuttings are discharged to the ocean and the mud is returned to the mud tank for recirculation down the hole. Drilling mud that adheres to drill cuttings is discharged to the ocean. Additionally, mud is discharged to the ocean when excess mud is generated by: (1) adding solids or water to adjust the mud properties; (2) changing mud types; and (3) dumping at the conclusion of drilling unless mud can be used in a subsequent well (Shenn Technical Subcommittee, 1976).

Removal of drilled cuttings from the hole is only one function of drilling mud. to obtain satisfactory results in the completion of any well, drilling muds have a variety of functions: controlling subsurface pressures, cooling and lubricating the bit and drill pipe, preventing the walls from caving, preventing clogging of the formation penetrated.

The divesity of drilling hole characteristics couples with the variety of purposes for which drilling mud is employed ensures that there is no "typical" mud. The ranges in weight of materials composing drilling mud are given in Table IV.A.8.c-1 for muds tested under the EPA guidelines. The concentrations of trace metals in whole muds (not used or diluted) are given in Table IV.A.8.a.c.2 for the EPA muds. Discharges of drilling mud must comply with requirements found under OCS Order No. 7 and the National Pollutant Discharge Elimination System (NPDES) permitting procedures. These requirements restrict the discharge of any drilling mud containing oil. Minerals Management Service (MMS) regulations state that if any oil base mud is used, the mud cannot be released to the ocean, and cuttings would be cleaned or barged to shore for disposal.

### (b) Discharge of formation water

Formation water is recovered along with oil during petroleum production. Formation water is derived from water that was laid down withinthe sediments in the geological past. During the compaction of the formation, some of this water has been displaced from the rock forming materials to turn into formation water. Consequently, formation waters reflect their environment of deposition.

After separating oil from formation water, the formation water may be disposed of by injection into disposal wells (wells drilled for the purpose of storing formation water), discharged into the marine environment, or disposed of using a combination of these two methods.

## Table IV.A.8.a.1

## COMPOSITION OF TESTED GENERIC MUDS

| Component | Range (pounds per barrel) |
|---|---|
| Barite | 0 to 450 |
| Attapulgite or Bentonite Clay | 10 to 450 |
| Lignosulfonate (Chrome and Ferrochrome) | 2 to 15 |
| Lignite | 1 to 10 |
| Drill Solids (Walnut shells and leather) | 20 to 100 |
| Sodium Hydroxide | 0 to 5 |
| Soda Ash/Sodium Bicarbonate | 0 to 2 |
| Cellulose Polymer | 0 to 5 |
| Lime (CaOH) | 0 to 20 |

SOURCE: Adapted from ERCO, Inc., 1980.

## Table IV.A.8.c.2

## METALS COMPOSITION OF DRILLING MUDS TESTED BY EPA PROGRAM

| Metal | Concentration (ppm-whole mud) |
|---|---|
| Arsenic | 1 to 3 |
| Barium | 2,800 to 141,000 |
| Cadmium | 1 |
| Chromium | 2 to 265 (1,159)*[1] |
| Copper | 2 to 26 |
| Lead | 1 to 24 |
| Mercury | 1 (0.015 to 0.07)*[2] |
| Nickel | 1 to 8 |
| Vanadium | 6 to 35 |
| Zinc | 12 to 181 |

(1) A Mobile Bay mud had 5,960 ppm Cr
(2) An arctic mud had 2.8 ppm Hg

SOURCE: Adapted from ERCO, Inc., 1980.

During initial oil production, formation water volumes will represent a small fraction (less than 1%) of the total fluid extracted from the well, with oil composing almost the entire amount of fluid. As the reservoir is depleted, the ratio of formation water to oil increases to as much as 10 to 1. The most common chemical constitutents found in formation waters are iron, calcium, magnesium, sodium, bicarbonate, sulphates, and chloride. In addition to these chemical constituents, formation waters contain entrained oil or petroleum hydrocarbons, numerous trace elements, and an absence of dissolved oxygen. Relative to ambient water, formation water has (a) increased organic salts, (b) increased temperature, (c) decreased dissolved oxygen, and (d) increased trace metals.

#### (c) Sewage

The daily volume of sewage that will be discharged will range from 7,600 gallons/day. Sewage discharge was estimated as 60 to 80 gallons/day/person on the platforms.

Estimates of typical volumes of sanitary and domestic wastes of offshore facilities have been developed by U.S. EPA (1976) and are shown in Table IV.A.8.a.2.

Table IV.A.8.a.3

TYPICAL RAW COMBINE SANITARY AND DOMESTIC WASTES
FROM OFFSHORE FACILITIES

| Number of Inhabitants | Flow Gal/Day | BOD, mg/1 |  | Suspended Solids, mg/1 |  | Total Coliform (x 10) |
|---|---|---|---|---|---|---|
|  |  | Average | Range | Average | Range |  |
| 76 | 5,500 | 460 | 270-770 | 195 | 14-543 | 10-180 |
| 66 | 1,060 | 875 | NA | 1,025 | NA | NA |
| 67 | 1,875 | 460 | NA | 620 | NA | NA |
| 42 | 2,155 | 255 | NA | 220 | NA | NA |
| 10-40 | 2,900 | 920 | NA | NA | NA | NA |

(d) Hydrocarbon discharges

Hydrocarbons may be discharged into the marine environment as a result of accidental spills. The volume of oil which enters the marine environment will depend on the type of accident and is very difficult to predict. Once the oil enters the ocean, a variety of physical and chemical processes act to disperse the oil slick including spreading, evaporation of the more volatile constituents, dissolution into the water column, emulsification of small droplets, agglomeration sinking, microbial modification, photochemical modification, and biological ingestion and excretion. The rates at which the oil is removed from the ocean will depend on water temperature, current movements which may spread dissolution, wind speed which may aid evaporation and physical mixing by wind waves. A more complete discussion of these factors is found in Malins (1977) and Wolfe (1977).

(2) Onshore

The construction and operation of onshore facilities supporting OCS-related activities may affect local onshore water quality by increasing the number of point and nonpoint pollution sources. Increases of nonpoint waste sources due to site runoff may contribute particulate matter, heavy metals, petroleum products and chemicals to local streams, estuaries, and bays, causing temporary elevations in turbidity and pollutant levels. During site preparation the vegetation is cleared from the area, and the topsoil is compacted by the constant movement of heavy machinery, which in turn alters the retention properties of the soil and gives rise to increased erosion and runoff from the site. By controlling the erosion generated within the construction site boundaries, several of the adverse impacts can be localized and prevented from having offsite impacts on water bodies. Land clearing and associated development changes the natural process of stormwater runoff, as the volume and rate of runoff increases as the natural vegetation is modified. Two major pollutants are contained in this runoff--suspended solids (organic and inorganic) from exposed soil at the site and contaminants such as heavy metals. Impacts of heavy metals or other contaminants contained in runoff on receiving waters will depend upon two factors. The first is the nature of the runoff and the level of concentration of heavy metals. The second factor is the nature of the receiving waters and the species diversity. Some heavy metals are extremely toxic, even if low concentrations, while others have accumulative effect as organisms ingest them.

Increases of point source discharges may also contribute to effluent discharges of domestic wastewater, cooling and boiler water, process water, and in marine terminal areas, the discharge of ballast and bilge water. The following discussion on wastewater effluents dishcarge to surface waters by OCS-related support facilities is largely taken from NERBC (1976).

Wastewater effluents from OCS-related support facilities are commonly discharged to surface waters after treatment. Although the degree of environmental damage, if any, will be related directly to the toxic nature of the discharge and the biota present in the receiving waters, certain characteristics of the discharge zone are important. these include: the size of the effective mixing zone (dilution factor) or the ratio of discharge volume to receiving waters, certain characteristics of the discharge zone are important. These include: the size of the effective mixing zone (dilution factor) or the ratio of discharge volume to receiving volume; the flushing rate of residence time (estuaries characteristically have a slow flushing rate); and the physical-chemical characteristics of the receiving waters, e.g., marine waters have a higher buffering capacity than fresh or estuarine waters.

Cooling water represents a signficant proportion of the wastewater effluent from an oil refinery. Substances concentrated in the blowdown and heat added during the condenser cooling operations could produce serious impacts on the receiving waters. Chemicals added to the cooling waste stream to reduce corrosion and fouling within the tower and the condenser system (including chromium and chlorine) may be extremely toxic to aquatic organisms. The presence of these substances could increase many adverse impacts of heated discharge on the receiving water body.

Domestic wastewater from support facilities will be collected and delivered to a municipal treatment plant or will receive secondary treatment in an onsite package treatment plant that includes chlorination prior to discharge to the receiving waters. Should these receiving waters also contain high organic carbon concentrations, organic chlorine compounds (e.g., chloroform, chloramines) which are highly toxic to certain aquatic organisms will be produced. Discharge of properly treated sewage wastewater into urban harbors is not expected to measurably degrade the receiving waters.

Although it does not constitute the greatest volume of water used in refining operations, process water may be the most contaminated. Processing pollutants are added during crude oil desalting, steam distillation, steam stripping, etc. In general, the quantity and hazardous nature of process water is a function of the size of the facility (in terms of barrels/day) and the degree of processing. Process water discharged from plants is of considerable volume and is highly toxic due to its anaerobic and highly reduced character and the presence of numerous heavy metals, sulfides, and ammonia which were produced together with the oil and gas. Three substances--mercury, cadmium, and cyanide--present in the effluents of OCS-related support facilities have been designated "toxic pollutants" pursuant to Section 307(a) (1) of the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500) (38 CFR 18044). toxic pollutants are defined in Section 502 (13) as "those pollutants, or combinations of pollutants, including disease-causing agents, which after discharge, and upon exposure, ingestion, inhalation or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will cause death, disease, behavioral abnormalities (including malfunction in reproduction) or physical deformations in such organisms or their offspring."

Point source discharges will be subject to treatment by municipal and industrial facilities in compliance with Federal and State discharge permit requirements. NPDES permits are issued on a regional and a facility-by-facility basis, limiting the quantities contaminants in and the temperature of each facility's effluent. These limits reflect a site-by-site specific analysis of flushing and mixing zone rates of the receiving body and indigenous population's ability to tolerate elevations of temperature and pollutant concentrations.

### b. Effects on Marine Life (Effluents)

The effects on marine life of materials other than petroleum hydrocarbons (discussed in Section IV.A) which are discharged into the ocean are discussed in this subsection. Resuspended bottom sediments, drilling cuttings and muds, formation water and discharged wastewater may all have impacts on marine biota. The effects on marine life from resuspended sediments resulting from pipeline laying or platform placement would primarily be through turbidity or smothering effects. This mechanism of impact is believed to be the principal one for drilling muds and cuttings and thus, the conclusions or research regarding fluids and cuttings effects are applicable to a large extent to sediment perturbations. The volume of wastewater expected to be discharged is very small given the volume of ocean receiving the wastewater and should present an insignificant impact in most areas.

#### (1) Resuspended Bottom Sediments

Suspended solids may significantly decrease light penetration in water, thereby decreasing photosynthesis in aquatic plants. These solids may also cause abrasive injuries and gill clogging in fish and can smother eggs and larvae on the bottom. They may provide additional substrates for bacterial decay, leading to oxygen depletion of bottomwaters. Alternately, they may contain nutrients which increase growth rates of endemic plant and animal populations.

### (2) Drill Cuttings and Muds

Drilling mud will be discharged into the ocean as described previously. The fate and effect of fluids has been discussed at length in the Symposium on Research on Environmental Fate and Effects of Drilling Fluids and Cuttings (Courtesy Association, 1980), Dames and Moore (1980), Neff (1981), Petrazullo (1981), Academy of Sciences (1983), and in the Panel report on Asessment of Fates and Effects of drilling fluids and cuttings in the marine environment. Direct impacts of drilling fluids and cuttings are via smothering or toxicity of mud components. Experiments by Shinn et al. (1980) indicate short-term (acute) toxicity of approximately 500 ppm for the hard corals Montastrea annularis and Agaricia garicites. The research indicated hard corals could survive short-term impacts within the 6 m of a discharge site. However, other research (Hudson and Robbin, 1980; Thompson andBright, 1980; Kune and Biggs, 1980) showed sublethal impacts could be very damaging to corals within an estimated distance of 3 meters.

The toxicity of drilling mud is debated amoung groups concerned with OCS-related impacts. The data to date, although having shortcomings in several cases, indicate that muds have low toxicity when compared to petroleum hydrocarbons, trace metals in wastewater, or industrial wastes. This conclusion is based primarily on short-term, 96-hour static bioassays of used drilling muds and drilling mud components. Research has also included a number of sublethal and long-term (106 day) experiments with a range of invertebrates (crustaceans, annelids, mollusks). The sublethal and long-term study data tend to support the conclusion of low toxicity of muds but some data indicate interference with growth in oysters and pecten clams at concentrations of 100 ppm. Differences in results among studies are probably due in large part to the differences in the methods of testing rather than differences in the toxicity of muds. There currently is no standard method for testing marine organisms exposure to drilling muds.

It should be pointed out that any toxicity associated with drilling (as opposed to their physical effects via possible smothering) is most likely attributable to their trace metal content or, in a few cases, to the presence of diesel fuel used in mud to free stuck drilling bits (K. Ranga Rao, 1983 Workshop on Adaptive Environmental Assessment, Breckenridge, Colorado comments during discussion). Muds which have had diesel oil added to free drilling pipe are generally not a problem because they must be barged to shore as in the case of any oil-based mud. Trace metals in water-based muds may present some toxicity to marine organisms but generally it seems that toxicity values are low (high ppm or pp thousand required to elicit toxic effects). Many organisms, making use of a class of proteins called metallothioneins, are able to bind up trace heavy metals allowing organisms to accumulate what would otherwise be very stressful levels of metals (Viarengo, et al. 1981). As in the case of shellfish, water quality changes may not kill the organisms but may contaminate it so that it cannot be safely used as a human food source, or tainting of the flavor may occur, making it undesirable for human consumption. These metals may also exhibit a toxic effect to consuming organisms higher in the food chain due to increases in concentration with each step in the food chain (NERBC, 1976).

### (3) Formation Water

Formation water may affect both water quality and marine life. The primary concern regarding biological effects of formation water centers on the trace metal content, hydrocarbon content, and oxygen demand (amount of dissolved oxygen removed from the ocean by chemical action) of this discharge.

Acute toxicity of formation water was investigated by Zein-Eldin and Keney (1978) and Rose and Ward (1980). The earlier study reported 96-hr LC50 values for juvenile white shrimp of 1,750-6,000 ppm formation water and a second set of data showing 96-hr LC50 values greater than 100,000 ppm. The first set of values were obtained using formation water treated with two biocides while the second data set was obtained from untreated formation water. The lowest 96-hr LC50 values obtained by Rose and Ward were 7,000-8,000 ppm formation water for larval brown shrimp. This formation water had a high oxygen demand relative to the conditions around the real discharge in the Buccaneer Field (Gulf of Mexico). It seems, therefore, that acute toxicity of formation water may be associated principally with removal of oxygen from sea water or indirectly by biocides added to waters prior to discharge.

The long-term sublethal effects of formation water are unknown (beyond the lack of obvious effects in historical producing areas such as the Gulf of Mexico) although the sublethal effects of trace metals on organisms are known for a variety of metals and marine organisms (e.g., Reish et al., 1976; Oshida et al., 1981). Galloway et al., 1980, studying the effects of formation water on the fouling community on platforms in the Buccaneer Oil Field and the associated reef and demersal fishes found reduced biomass and production levels restricted to 1 meter vertically and 10 meters horizontally in the fouling community on the platform. Galloway found elevated alkane levels in sheepshead collected near the platforms but less than normal histopathological anomalies (fish were "healthier: near the platforms). Crested blennies around the platforms showed results similar to the sheepshead; spadefish showed no evidence of petroleum or trace metal contamination attributable to Buccaneer Field operations; and red snapper showed gill deformaties in 62 percent of the fish collected. However, more work is needed to understand the population dynamics of the red snapper and the correlation between red snapper gill abnormalities, and formation water discharge may or may not be real.

### (4) Discharged Wastewater

Wastewater effluents from OCS-related facilities produce a wide range of responses in the receiving waters. Environmental responses produced will depend upon the quantity and kind of pollutants discharged or spilled. Heavy metals (such as zinc or copper), although often essential or nontoxic to organisms in very low concentrations, become toxic in higher concentrations. Even if the concentration of a heavy metal in the water is not toxic, it may accumulate in tissue with ultimately lethal effects. Ammonia can alter the pH of water, thus harming pH-sensitive organisms. Antifouling substances, which are added to cooling water to kill algae and bacteria, have similar effects on the organisms present in the water into which they are discharged. Suspended solids significantly decrease light penetration into the water, thus decreasing photosynthesis in aquatic plants. They also cause abrasive injuries and gill clogging in fish and can smother eggs and larvae by blanketing the bottom. Suspended solids which settle on the bottom provide additional substrates for bacterial decay, leading to oxygen depletion of the bottom waters. Thermal discharges can alter the chemical nature of receiving waters in many ways. Solubility of dissolved oxygen, toxicity of heavy metals, and metabolic rates of aquatic organisms are affected by changes in water temperatures.

The environmental impacts associated with oil and heavy metal pollution in the marine environment include both toxic and sublethal responses. Juvenile forms of many species of marine fauna are particularly sensitive, and an age class may be totally eliminated by a specific dosage of oil or some heavy metal. Sublethal physiological alterations include depression of growth and photosynthesis in marine flora.

### c. Air

This section describes significant emissions of air pollutants associated with typical OCS activities. Air pollutants discussed include nitrogen oxides (NOx), carbon monoxide (CO), sulfur oxides (SOx), total suspended particulates (TSP, and volatile organic compounds (VOC)*. Ozone (O3) is not emitted directly by any source, but is formed in a photochemical reaction in the atmosphere involving VOC, NOx and other pollutants. The pollutants discussed below are regulated by Federal and State agencies to prevent adverse effects on human health and welfare.

NOx consists of nitric oxide (NO) and nitrogen dioxide (NO2). NOx is formed through the combination of oxygen and nitrogen in the air during combustion processes, and the rate of formation increases greatly with combustion temperature.

CO is formed by incomplete combustion. It is mainly a problem in areas where there is a high concentration of vehicle traffic. CO is a serious health threat to humans when present in sufficient concentrations.

SOx is formed in the combustion of fuels containing sulfur. Emissions are usually in the form of sulfur dioxide (SO2). SOx in the presence of fog or clouds may produce sulfuric acid mist. Entrainment of sulfur oxides or sulfate particles into storm clouds may be a signficiant contribution to reduced pH levels in precipitation (acid rain).

TSP emissions associated with combustion consist of fine particles (less than 10 microns in diameter). Particulates, especially those in the size range of 1 to 3 microns can cause adverse health effects. Particulates in this size range also tend to reduce visibility if present in sufficient numbers.

VOC emissions result from evaporation of hydrocarbon compounds, processing of hydrocarbon compounds, and incomplete combustion of fossil fuels, and are defined for this EIS as those compounds that are unreactive (such as methane and ethane).

The type and relative amounts of air pollutants generated by offshore operations varies according to phase of activity. There are basically three phases: the exploration phase, development phase, and production phase. A more detailed discussion of emission sources associated with each phase is presented in POCS Technical Paper No. 83-8 (FSI, 1983). The various emission sources are summarized below.

### (1) Offshore Emissions

#### (a) Exploration Phase

Emissions are produced by 1) diesel-fired power generating equipment needed for drilling exploratory and delineation wells, 2) tug boats, supply boats and crew boats in support of drilling activities, and 3) intermittent operations such as mud degassing and well testing. Pollutants consist primarily of nitrogen oxides (NOx), carbon monoxide (CO), and sulfur oxides (SOx).

#### (b) Development Phase

The primary offshore emission sources are (1) diesel or natural gas driven turbines used to provide power for drilling development wells; (2) heavy construction equipment used to install platforms and pipelines; and (3) tug boats and supply boats. The principal development phase emissions consist of NOx with lesser amounts of SOx, CO and total suspended particulates (TSP).

#### (c) Production Phase

The most significant source of offshore emissions is from power generation for oil pumping, water injection, and gas compression. The emissions consist primarily of NOx with smaller amounts of TSP and CO. Other sources of air pollutants include evaporative losses (VOC) form oil/water separators, pump and compressor seals, valves, and storage tanks. Flaring is a source of VOC and SOx. Gas processing, which involves gas-liquid separation, dehydration, and desulfurization results in emissions of VOC, NOx, and SOx.

### (2) Onshore Emissions

#### (a) Exploration Phase

Onshore emission sources consist of vehicles transporting personnel and materials, and support vessels operating in the harbors. Pollutants generated in this phase of development primarily consist of NOx, CO, and SOx.

#### (b) Development Phase

Significant emissions consist of (1) crew and supply boats operating in port, (2) support vehicles, and (3) construction activities associated with gas processing facilities and pipelines. Emissions consist primarily of NOx, CO, TSP and SOx.

### (c) Production Phase

Onshore emission sources consist of (1) gas processing facilities, (2) tanker activities at marine terminals, (3) crude oil storage, (4) pipeline facilities, and 5) refineries.

Emissions from gas processing facilities are similar to those described under offshore sources. Tanker emissions consist primarily of exhaust emissions (NOx and SO2) from the ship's engines and VOC losses associated with tanker loading operations.

Pipeline facilities emit minor quantities of pollutants from pumps, compressors valves, and related equipment. Pollutants consist of primarily of VOC and NOx.

Crude oil may be stored in floating roof tanks or in fixed roof tanks equipped with a vapor balance line. Emissions from floating roof tanks consist of standing losses and withdrawal losses. Standing losses of VOC and $NO_x$ are from vapor escaping due to pressure differences. Withdrawal losses result from evaporation of hydrocarbons clinging to the tank wall as the floating roof descends. Emissions from tanks equipped with a vapor balance line would be very small. Operational emissions from offshore activity and onshore activities such as refineries, and gas processing plants typically emit constant levels of VOC, NOx, CO, HC, SO2, and TSP. The levels of these emissions are typically not extreme; thus, it is the effect of these emissions on the ambient air quality that is of concern.

### (d) Assumptions used in Air Quality Analysis

Effects on air quality from offshore oil and gas development here and in sole specific EISs are based on a generic impact analysis, tailored to probable facility patterns associated with the sale. Assuming probable exploration and development scenarios, production rates, and transportation. A more detailed analysis on site specific activity plans (POE/D) is performed prior to permitting exploration and development plans. Emission data are calculated assuming a generic type facility. Actual emissions for individual facilities may differ considerably depending on actual facility construction. This analysis cannot take place until after it is known where resources are.

Air pollutants emitted as a result of typical oil and gas development on the OCS include nitrogen oxides (NOx), carbon monoxide (CO), sulfer oxides (SOx), total suspended particulates (TSP), and volatile organic compounds (VOC)*. Ozone (O3) is not emitted directly by any source, but is formed in a photochemical reaction in the atmosphere involving VOC, NOx, and other pollutants.

Sources of air emissions during the drilling of exploratory wells include diesel-fired engines that power the drilling units and engines that power the tug boats, crew boats, and supply boats. Pollutants primarily consist of NOx, with smaller amounts of CO, VOC, and TSP. During the installation of a platform, air emissions are associated with derrick barges, tugboats, and cranes. Pipeline installation results in similar type of emissions, but total amounts are much lower since they occur over a much shorter period of time. The drilling of development wells is initially performed by diesel engines; however, once production starts, natural gas turbines are used. The largest contribution to air emissions during development consists of NOx, while emissions of CO, VOC, SOx, and TSP are considerably smaller. However, NOx emissions are reduced substantially once the diesel engines are replaced by natural gas turbines. Table IV.B.7.a(3)(b)-1 lists typical emission rates associated with exploration and development activities.

During oil and gas production the primary source of emissions is from natural gas turbines that provide power for oil pumping, water injection, and gas compression. The emissions consist primarily of NOx with lesser amounts of CO, VOC, TSP and SOx. Other sources of air pollutants include leakage of VOC vapors from oil/water separators, pump and compressor seals, valves, and storage tanks. Flaring may take place periodically to burn off excess gas, resulting in some emissions of SOx and VOC. If the gas produced is high in hydrogen sulfide (H2S), the gas would have to pass through a desulfurization unit. Onshore emissions result primarily from gas processing facilities.

If barges or tankers are used to transport crude oil to shore, emissions of VOC result from tanker loading operations. Emissions of SOx, NOx, and TSP from the ship's engines occur during loading operations, tanker transit, and tanker operations in port. Emissions of VOC also occur during unloading and ballasting operations in port.

### 9. Socioeconomic Assumptions

Oil and gas exploration, development and production activities on the OCS, as well as service and processing facilities onshore and offshore, may result in changes in the socioeconomic characteristics of the coastal region. The degree to which an area is affected by economic change depends primarily on the size and nature of the proposed action and the area's economic base. The important socioeconomic indicators are current levels of employment and income, the availability of housing and public services and the existing oil and gas infrastructure. Descriptions of the existing socioeconomic characteristics of the OCS planning areas can be found in Chapter III.

The economic analysis is based on the most likely resource estimates and transportation scenario. The impacts on employment, income, population, and housing expected to result from the proposal are distributed among the coastal counties according to the location of the onshore oil and gas infrastructure designated likely to service specific offshore activities.

The indirect/induced employment projections are based on the applications of industry- and region-specific gross multipliers. The regional economic effect of a proposal is composed of an initial impact and a secondary impact. The initial change introduced into the economy is defined in terms of the initial change in the final demand of a set of industries. The secondary impact is estimated with the application of the industry- and region-specific multipliers.

Total direct, indirect, and induced employment is converted to new resident employment based on the level of unemployment expected in a particular area at the time the OCS-related activities occur.

Estimates of income, population, and housing resultant from OCS-related total or new resident employment are made by the use of gross region and possible industry specific ratios such as the average payroll per employee, population/employment ratio, or average housing units per population.

The direct employment projections are based on the activities presented in the following list of parameters:

Delineation and Exploratory Wells
Development Wells
Platforms
Pipeline Landfalls
Treating Facilities
Marine Terminals and Storage Facilities

The impact of the proposed OCS activity is based on a comparison of the proposed new resident analysis results to the base case conditions. The impact conclusions are based on the percent change from the base case conditons resultant from the proposed action. The magnitude of this change is evaluated as very low to very high in accordance with the impact definitions provided in Appendix A.

### 10. Effects of the Physical Environment on Oil and Gas Operations

#### a. Geologic Hazards

Geologic hazards are any geologic features or processes, existing or potential, that could inhibit the exploration and development of oil/gas resources.

Most geologic hazards are potential rather than actual and continuous threats. Where geologic hazards are identified, special engineering procedures may be required for bottom-founded structures and facilities, and proposed drilling sites will have to be carefully evaluated. Unless geologic hazards are taken into account in the design, installation, and operations of offshore facilities, such phenomena, if activated, could cause pollution, damage, or loss of lives or equipment.

### (1) Steep Slopes/Steep-Walled Canyons

Slopes are arbitrarily classified as flat, gentle, moderate, or steep. Flat slopes are defined as the horizontal sea floor. Slopes less than 5 degrees are considered gentle, slopes of 5-10 degrees are moderate, and slopes greater than 10 degrees are steep. Only steep-walled canyons and steep slopes are considered to be hazards, especially those with sediment cover. Steep slopes on canyons would be hazardous mostly in their instability as platforms are not placed on steep slopes because of construction problems.

### (2) Seismic Activity

Seismic activity is intense along the entire Pacific coast. The earthquakes occurring along this coastal arc are caused by the physical interaction between crustal plates. Numerous earthquakes ranging in magnitude from 4 to 8 have been recorded during this century. The potential hazards associated with these magnitudes are ground motion, fault displacement, surface warping, tsunamis, ground failure, and consolidation of sediments. Any of these could cause the failure of a platform structure or a pipeline.

The potential for damage from ground motion is the greatest in areas underlain by thick accumulations of saturated, unconsolidated sediments. Sediments can be weakened and other hazards such as slumping, landslides, and turbidity currents can be triggered, causing the parting of pipelines or the toppling of platforms.

Large earthquakes can also produce wide areas of surface warping or deformation. Subsidence can also result from consolidation and/or lateral spreading of sediments. This type of hazard can lead to extensive flooding along coastal areas, damage to drilling equipment or platforms and severing of pipelines.

The presence of active faults is a moderate constraint to offshore drilling programs and bottom-founded oil facilities. Any movement along the features, such as that generated by an earthquake, could be a threat to the drillstem or could affect the stability of surficial sediments. Displacement of sediments could occur. Slumps and turbidity currents could be triggered on the continental slope, causing the failure of pipelines.

Unconsolidated sediments deposited off rivers and streams are highly susceptible to ground failure if deposited on slopes along the shelf edge and along the walls of sea valleys. Possible triggering mechanisms for sediment failure could include overloading by continuing deposition or by manmade structures, excessive steepening by erosion, buildup of excess pore-water pressures in under-consolidated sediments that have accummulated rapidly, cycle loading by storm waves, agitation by tsunamis, and prolonged ground shaking during earthquakes. Such failures could cause shifting and possible collapse of platforms.

Tsunamis and seiches can be generated by sudden tectonic displacement of the sea floor or by large landslides triggered by seismic activity. In open water and in greater depths, tsunamis generally have no effect. In lesser depths, especially along identified coastlines and within enclosed bodies of water, they become a potential danger to any onshore or shallow-water facilities such as production platforms.

### (3) Vulcanism

The major threat from active volcanoes along the Pacific coast and Alaska is the direct blast. However, other potential hazards that are related to this type of event and are also destructive are nuee ardent (incandescent cloud of gas and volcanic ash), mud flows, lava flows, bomb and ash fallout, tsunamis, and seiches.

### (4) Shallow Gas

Dissolved or undissolved gas either dispersed or in pockets can be a serious hazard to platforms, supports, pipelines, and subsea installations. Gas-charged sediment can contribute to low shear strength or promote liquefaction. Storm surges or seismic shaking, coupled with an upward release of gas, could trigger slides and subsidence. Their identification is important to any drilling program because of the danger of ignition or blowout. Shallow gas may weaken shallow geologic formations providing avenues of escape for high pressure fluids and gas from deeper formations.

Buried channels are formed when ancient stream channels were filled with sediment of different composition and consolidation from that in the walls of the channel (Carlson et al., 1982). Such conditions lead to differential consolidation and accumulations of shallow gas. Shallow gas erupting to the surface in such conditions beneath a jack-up drilling rig could cause the structure to shift and topple.

### (5) Permafrost

Potential hazards associated with the presence of permafrost (in Alaska) include thaw subsidence and frost heave. Thawing produces undesired plasticity in the sediment causing differential subsidence of the surface or lateral flow because of reduced bearing strength. This could cause differential settling of platform foundations, onshore service or processing facilities, and pipelines.

Fine-grained soils are more susceptible to frost heave than are coarse-grained soils. Thaw subsidence or frost heave may result in the uneven settling or uplifting of the foundations of structures and this could endanger the operation that the structure was designed to perform.

Natural gas hydrates have been encountered in bore-holes drilled not only in the arctic offshore and onshsore environments, but also in holes drilled in the seafloor in many other areas throughout the world in recent years (Kvenvolden, 1982). Thus, the amount of experience associated with drilling through hydrate layers is increasing.

### (6) Karst

Karst features are widespread but noncontinguous in distribution on the west Florida platform from the Florida Middle Ground to the Florida Keys and on the Blake Plateau. Surface expression of the karst is evidenced in some areas; while in other locales, subsurface karst is inferred from the seismic anomalies. The karst consists of concentrations of dolines (sinkholes) formed by either solution of surface limestone or by collapse of underlying solution caverns, and in some areas a rough barren topography of deep furrows or channels which reflect surface solution along joint patterns. Collapse of solution caverns beneath bottom founded drill rigs or platforms, or the blowout of unsupported drill casing on production lines are the major hazards from karst.

## b. Physical Oceanography

Oceanographic conditions in the Gulf of Mexico can be characterized as dynamic, yet not extremely harsh. Extreme physical conditions are infrequent; however, they can occur throughout the year. Summer and early fall offer possibilities that tropical storms may affect the area through characteristically high winds (18+ m/sec), waves (7+ m), and storm surge (3-7.5m). Winter storm systems frequently cause moderately high winds, waves, and storm conditions that occasionally mask local tides. These conditions, while sometimes harsh, do not have the potential to create extreme conditons as harsh as those associated with tropical storms.

Hurricanes vary considerably in intensity, track patterns, and behavior. Damage results from high winds and, particularly in the coastal areas, the storm surge or tide which is an abnormally high rise in the water level. Maximum surge height at any location is dependent on many factors including bottom topography, coastline configuration, and storm intensity. The storm surge associated with Hurricane Betsy in 1965 reached nearly 6.1 m (20 ft.) at Bayou Lafourche; however, Hurricane Carla in 1961 produced 7 m (23 ft.) tides in Lavaca Bay, Texas. Hurricane Camille, the most severe hurricane in recent Gulf history, attained top winds estimated at 324 km/hr with barometric pressure in her eye as low as 68 cm (26.6 in.) of mercury and in late August 1977, Hurricane Anita came ashore just south of the United States border in Mexico after tracking through the Gulf and bringing storm surges to various parts of the Texas and Louisiana coasts. Hurricane Babe, just strong enough to be termed a hurricane, developed three days later, but caused no significant offshore damage when it came ashore near Morgan City, Louisiana.

Annual hurricane threats have been an important consideration to the petroleum industry since offshore operations began. Its activities are ruled by the daily presence of the potential for such a phenomenon to occur. Though little or no damage may be incurred during such an event, evacuation and shut down costs to industry can be costly.

Sea ice is the most constraining feature to the offshore development of petroleum hydrocarbon resources in arctic areas. The forces exerted by the sea ice depend upon such factors as the movement rate, strength, thickness, and type. With so many variables, an analysis of the mechanical behavior of the ice is very complex.

The constraints on oil and gas activities imposed by sea ice conditions have brought about technological advances and innovations since the beginning of hydrocarbon resource development in the arctic. Wells have been successfully drilled and completed from different types of drilling units in a variety of northern marine environments.

The formation of ice on superstructures is a complex process that depends on sea conditions, type of offshore drilling platform, atmoshperic conditions, and ship size and behavior.

Offshore oil exploration and production depend on moderately sized vessels for logistic and rescue support. Historically, sea spray icing in polar seas has plagued vessels and has, in extreme cases, resulted in capsizing both fishing and moderately sized ships, with total loss of ship and crew.

Superstructure icing originates from sea spray, atmospheric water, and frost smoke. Sea spray is the most common and dangerous form of icing. Icing can occur when the air temperature falls below freezing with windspeed greater than 30 knots (35 miles per hour). Wind-induced spray may then freeze before striking a structure.

Like the Gulf of Mexico, oceanographic conditions in the Atlantic Region can be characterized as dynamic, but not excessively harsh. Conditions appear to be harshest in the North Atlantic where tropical storms may result in wind speeds as high as 100 knots and wave heights greater than 40 ft. Extreme winter temperatures and wind chill factors may also create problems in terms of ice accretion and superstructure icing. Concern had, in the past, been expressed concerning the effects of the high-speed currents circulating around Georges Bank on drilling rigs operating in the area. However, no adverse effects have been noted from drilling operations which have already taken place.

Oceanographic conditions is least pronounced in the Mid-Atlantic where oceanographic conditions should not present any major hazards or difficulties. In rare instances tropical storms may result in wave heights greater than 40 ft.

In the South Atlantic the greatest concern appears to be the extreme high-speed currents associated with the Gulf Stream. These currents may create difficulties to drilling rigs in terms of maintaining correct position over the well hole; bending of the drill string may also occur in response to high speed currents. The South Atlantic region also experiences the greatest amount of hurricane activity. High speed winds associated with the hurricanes many result in extremely high wave heights.

Physical oceanographic forces due to currents and waves are believed to pose no threat to the physical integrity of drilling rigs or production platforms. Oil and gas structures are engineered to withstand the maximum expected currents, which are generally less than 50 cm/sec in the lease sale area, and also 100-year expected storm waves, which are generally less than 12 meters in the area. Storms and the associated waves may cause cessation of some activities on rigs and platforms because of danger to personnel transfer from shore boats or the danger and spill hazards involved in off-loading oil from platforms to tankers (if this method of transportation is selected). This is only expected to occur in seas of 3 meters or greater. Bottom currents are not expected to affect the tranportation of oil and gas by pipeline.

Exceptions to the above are in the areas near shore where wave energies may be magnified in the shallow water. A recent example of structure failure to withstand severe storms occurred in State of California waters when oil island Esther was destroyed by high waves occurring during high tide and large storm surge. The reason for the failure is being investigated. No damage was reported from any platforms in federal or deeper state waters.

### c. Meterology

The Northern Gulf of Mexico coastal waters experience a relatively high frequency of restricted visibilities that could occasionally hinder the movement of crew boats and supply vessels. However, dense fog occurs less than 1 to 2% of the time and would seldom be expected to last long enough to cause significant delays in OCS operations.

Strong winds and high waves during hurricanes should be expected in any year. These storms along with tropical storms occur mainly in the summer and fall months. Hurricanes will disrupt all activities and may cause structural and other damage. Tropical storms would disrupt construction and movement of crew or supply boats and helicopters. However, these conditions seldom persist for more than two or three days. Strong winds and high waves can be expected three to five times a year during the winter months whenever cold fronts penetrate southward into the Gulf. Cyclones occasionally form on these frontal surfaces and would produce conditions affecting vessel movement.

On the average, the climatological characteristics of the three regions are not particularly harsh. However, extreme events which may be considered limiting to offshore operations occur in all three regions.

Surface winds play a critical role in determining the movement of spilled oil and other pollutants in the marine environment, particularly at the surface. Wind-driven waves may be among the most serious weather-induced problems affecting offshore development. The prevailing surface winds over the regions are from the west, with a general shift to the northwest during the winter and to the southwest during the summer.

Northeasters (extratropical cyclones) can affect the North, Mid-, and South Atlantic regions. However, maximum severity occurs in the former. These storms can be accompanied by winds of gale or hurricane force. Among the regions, the South Atlantic is more often affected by tropical cyclones than the regions to the north. The Florida peninsula and the vicinity of Cape Hatteras, NC, are particularly vulnerable. North of Cape Hatteras, tropical cyclones have lost most of their intensity, and show characteristics similar to extra tropical storms.

## B. Environmental Consequences by Planning Area

### 1. North Atlantic

### a. Alternative 1

### (1) Interrelationship of Proposal with Other Projects and Proposals

### (a) Coastal zone management

Presently, all affected states of the North Atlantic Planning Area possess Federally approved coastal zone management (CZM) programs. State CZM programs may restrict the placement of pipelines, refineries, or other support facilities in areas of particular environmental concern and may set standards for their placement elsewhere. However, some provisions for their appropriate location is required by the CZM Act, as amended.

Maine's program (MCP, 1978) declares that "OCS-related development is permitted in Maine's coastal area subject to applicable laws." This approach is similar to that of other Atlantic States with approved coastal management programs. However, the MCP goes further to state a commitment to preparing for OCS development. New Hampshire's coastal program (NHCP, 1982) notes that the State "shall accommodate the exploration, development, and production of Outer Continental Shelf (OCS) oil and gas resources while minimizing the adverse effects of these activities on the coastal and marine environment." The program also includes a planning process for energy facility siting. The policies of the Massachusetts Coastal Zone Management Program (MCZMP, 1978) include the accommodation of "exploration, development and production of offshore oil and gas resources while minimizing impacts on the marine environment . . . and . . . conflicts with other maritime-dependent uses of coastal waters or lands." Thus, the Program will permit OCS development if special care is exercised to avoid harm to coastal resources which benefit the Commonwealth's citizens. The Rhode Island Coastal Management Program (RICMP, 1978) encourages the development of OCS oil and gas resources, provided that certain policies discussed in the approved Program, and elaborated upon in the 1978 State Energy Amendments, are adhered to. The 1978 State Energy Amendments include a policy recognizing that "Maintenance of a high quality of life and of reliable and reasonably priced sources of energy are related, not conflicting, goals." The State of Connecticut recognizes the importance of OCS oil and gas development and notes that these resources should be "developed in an orderly manner consistent with national energy and environmental policies" (CCMP, 1980). The coastal management programs of those States not mentioned here which may be affected by OCS development in the North Atlantic Planning Area (i.e., New York and New Jersey) are included in the mid-Atlantic coastal zone management discussion [see Section IV.B.2.a(1)(a)].

The Federal Coastal Zone Management Act, in addition to promoting State CZM programs, established the Coastal Energy Impact Program (CEIP). The CEIP includes the following: grants for planning for social, economic, and environmental consequences of expected energy development; financial assistance for new or improved public facilities and services; and grants to ameliorate damage to recreational or other environmental resources when the responsible party cannot be found or charged with damage. Under the CEIP, numerous facility siting studies have been conducted by the States to identify compatible sites for OCS facilities. These studies will aid in the process of assuring that OCS activities do not result in otherwise avoidable conflicts.

For past OCS lease sales in the North Atlantic Planning Area, the Minerals Management Service has analyzed generally foreseeable developments resulting from OCS exploration in relation to the States' coastal management programs. The reader is referred to the Environmental Impact Statements for Lease Sale Nos. 42, 52, and 82 for a detailed analysis of particular development assumptions and their relationship to coastal zone management efforts. The section entitled "Impact on Coastal Land Use" in this EIS provides an overview of the kinds of impacts which may result from the proposed action and its interrationship with coastal management programs and other land-use plans [see Section IV.B.1.a(5)(b)].

On the whole, it has been determined that a variety of options exist to ensure that OCS development can be accommodated within the context of coastal management efforts. The terms and configuration of the 5-year lease program, as proposed, contain no provisions that would prevent the program from being conducted in a manner which is compatible with the coastal management programs of the North Atlantic States.

#### (b) Ocean dumping

Ocean dumping activities and dumpsite locations in the North Atlantic Planning Area are discussed in Section III.A.1.a(6)-Ocean Dumping. Dumpsite locations are shown in Figure III.A.1.a.6-1. Dredged materials are the only materials presently being dumped in the area.

The five dredged materials dumpsites (three off the coast of Massachusetts and two off Maine) are within or close to State territorial waters which extend 3 mi out from shore. Being this close to shore, these dumpsites are highly unlikely to have any interaction, in terms of area use conflict or synergistic action of wastes, with the proposed OCS oil and gas activities. Should there develop a potential for area use conflict (e.g., OCS gas pipeline routing being proximate to a dumping site), this could be subsequently resolved through coordination and planning.

Within the planning area are four major sites formerly used for dumping of undetonated explosives (e.g., bombs and depth charges) and 1 major site for dumping radioactive materials (source and by-product matter) encased in steel drums. Disturbance of these potentially hazardous materials by OCS oil and gas activities (placement of 1 gas pipeline, installation of 2 production platforms and drilling of 44 exploration, delineation and production wells) resulting from the 2 sales in the North Atlantic Planning Area is highly unlikely. Also, MMS has authority under operating Order No. 2 to require a lessee to perform pre-drilling hazards surveys. This would include surveys to detect explosives and radioactive materials where such surveys may be warranted. Such precautions would minimize the probability that undetonated explosives or radioactive materials especially those concentrated within the former dumpsites, would endanger drilling activities, or that the radioactive materials would be released in the marine environment.

Overall, impacts from oil and gas operations on ocean dumping are anticipated to be low.

### (2) Projects Considered in Cumulative Impact Assessment

#### (a) Oil and gas activities (state and federal)

There are currently no active leases (either State or Federal) in the North Atlantic Planning Area. Therefore, the cumulative impact assessment will not consider oil and gas activities other than the proposed and alternative scenarios, including the transportation of domestic and imported crude oil and refined products.

#### (b) Military operations

Portions of the water and air space of the North Atlantic Planning Area are used for various military operations essential to training, readiness, and support of national defense and security interests. These operations include training and testing activities such as submarine operations, gunnery practice, sea trials, radar tracking, warship maneuvers, and general operations. These activities normally take place in operating areas specially designated for such purposes that are under the control of the Department of Defense. These operating areas were established for training of surface, submarine, and air units in addition to providing designated zones for testing explosives, aircraft, and ships.

Within the North Atlantic Planning Area there exist two military operating areas and an Air Force Warning Area (Figure III.A.1.a.6-1). The Boston Operating Area lies east of Massachusetts and Maine and covers much of the northern portion of the planning area. The Boston Operating Area's controlling authority is Commander, Submarine Squadron Two, Naval Submarine Base, Groton, Connecticut. The other military operating area is the Narragansett Bay Operating Area which encompasses the extreme western portion of the planning area. The controlling authority for this area is Commanding Officer Fleet Control and Surveillance Facility, Virginia Capes, Virginia Beach, Virginia. The Air Force Warning Area, designated as W-506, lies within the central portion of the planning area. This is a training area for high-speed aircraft operating out of various New England bases. The 21st Air Division located at Hancock Field, Syracuse, New York, is the manager for this area. The controlling authorities for each operating area are responsible for directing oceanic and air maneuvers in their respective jurisdictions and for coordinating them with other endeavors.

### (3) Physical Environment

### (a) Impact on water quality

#### (i) Offshore

Introduction to Impacts for the Atlantic Region: A general introduction to the sources or types of offshore water quality degradation expected in the Atlantic region (including North, Mid and South Atlantic Planning Areas) is presented in this subsection. This is then followed by a subsection addressing impacts specific to the proposed action in the North Atlantic Planning Area.

Under normal offshore operations, the primary sources of impacts on water quality in the Atlantic Region would include discharges (from exploratory and/or production rigs) of drilling muds and cuttings, formation waters, domestic and sanitary waste, and deck drainage. Discharge of these routine effluents is regulated by the U.S. Environment Protection Agency (EPA) through issuance of National Pollutant Discharge Elimination System (NPDES) permits. Additional routine pollutant sources would be the resuspended bottom sediments (primarily as a result of pipeline burial) and the operational oil discharges from tankers.

Accidental sources of offshore water quality degradation would include the small (usually less than 50 bbl) chronic oil spills resulting from such operations as fuel transfer or storage. A large (>1,000 bbl) oil spill or release may result from a well blowout, tanker or platform accident, or a pipeline break. Also, accidental gas release may result from a pipeline break or seam leakage.

Drilling Muds and Cuttings: Because of dilution, dispersion, and settling, the drilling discharges (muds and cuttings), and their associated elevated levels of suspended solids and trace metals, generally have limited impact on ambient water quality beyond the immediate vicinity of the discharge. The fate of these discharges in a particular area is greatly influenced by water currents and water depth. The lighter particulate and soluble discharge components associated with an upper or visible plume are generally dispersed or diluted to ambient levels within approximately 200 to 2,000 m of the discharge. The heavier drilling discharge materials tend to settle out in the general vicinity of the drilling rig. However, in deep water (greater than approximately 80 m), the settling of some of these heavier materials within the main or lower plume, may be temporarily delayed when encountering neutral buoyancy conditions within the water column (NRC-MB, 1983).

Dissolved oxygen, pH, salinity, and temperature would be affected only in the immediate vicinity (within approximately 40 m) of the discharge--temperature and pH may become slightly elevated while oxygen and salinity could decrease. Beyond the immediate area of discharge, the parameters that would be affected by drilling discharges are the levels of suspended solids and light transmittance (EG&G, 1982; Ayers et al., 1980a; Ray and Meek, 1980).

Trace metal dilution rates, as measured by suspended solids concentrations, have been shown to be similar to that of whole muds. Comparing the estimated concentrations of trace metals in drilling muds after 10,000-fold dilution (100 m downcurrent from the discharge point) with U.S. EPA criteria for saltwater aquatic life shows all estimated metal concentrations being below the EPA criteria levels, thus within "safe" levels. (See Table IV.E.1-2 in proposed Mid-Atlantic Sale No. 111 FEIS.) Light transmittance values reach background levels at a slightly greater distance from the discharge than do suspended solids because of colloidal particles (Ayers _et al_., 1980b).

Formation waters: The formation water (i.e., produced water) properties which may adversely affect the marine environment are entrained oil or petroleum hydrocarbons, high trace metal concentrations, low dissolved oxygen concentrations, and high levels of naturally occurring radionuclides. However, formation waters discharged during production tend to undergo dispersion similar to that described for fine particulate and liquid drilling discharges whereby they are rapidly diluted and ultimately lost in the large volume of receiving water.

Because of the relatively high density and low oxygen content of formation waters, if large volumes are discharged near the bottom in deeper areas where turbulence is not strong, high density flows of low oxygen water could result. If discharged near the surface, however, they would rapidly disperse in the water column within a few hundred meters and thereby have no substantial effect on ambient water quality.

The high trace metal concentrations in discharged formation waters are generally reduced to background levels within a few hundred meters, depending on hydrographic conditions. A comparison of the estimated concentrations of trace metals in typical California formation waters after 1,000-fold dilution (500 m from the discharge point) with U.S. EPA 24-hour water quality criteria showed all trace metals falling below EPA criteria "safe" levels. (See Table IV.E.1-3 in Mid-Atlantic Proposed Sale No. 111 FEIS.)

Studies done on Gulf of Mexico oil field production waters have shown radionuclide levels of up to 4 levels of magnitude higher than found in open ocean surface waters. Despite these levels in formation water as compared to open seawater, there seemed to be no apparent human health or environmental health contamination problem because of the rapid dilution of these formation waters when discharged offshore (Regional FEIS, Gulf of Mexico, 1983).

Hydrocarbons are present in formation waters as small droplets or in dissolved form. The U.S. EPA requires that before discharge, formation waters must be treated such that the concentration of oil does not exceed 72 mg/l (ppm) for any 1 day nor exceed an average 30-day concentration of 40 mg/l (40 CFR 435). Dilution models indicate that the areal extent of elevated hydrocarbon levels around a platform would be 0.1 sq mi for concentrations over 10 ppb and 0.001 sq mi for those over 1 ppm (Massachusetts Institute of Technology, 1973).

Domestic and Sanitary Wastes: Domestic waters (from sinks, showers, laundries, and galleys) and sanitary (sewage) wastes (from toilets and urinals) are discharged from drilling rigs and platforms. On the average, approximately 100 gallons/person/day are discharged from offshore oil and gas facilities. The discharge of treated sanitary and domestic wastes, regulated by U.S. EPA NPDES regulations (e.g., regarding floating solids and residual chlorine content), would increase levels of suspended solids, nutrients, chlorine, and BOD in a small area near the point of discharge. Some residual chlorine may be present in discharged waters following treatment; however, due to evaporation and conversion to other chemical forms when combined with sea-water, it would be quickly diluted.

Deck Drainage: Deck drainage includes all effluents resulting from platform washings, deck washings, and run-off from curbs, gutters, and drains including drip pans and work areas. Constituents of concern in effluents are oil and grease. NPDES permit regulations specify there should be "no discharge of free oil" in deck drainage which would cause a film, sheen, or a discoloration on the surface of the water or cause a sludge or emulsion to be deposited beneath the surface of the water (40 CFR 435). In compliance with this requirement, contaminated deck drainage is collected by a separate drainage system and treated for solids removal and oil/water separation. The oil is then held for shore disposal.

Operational Discharges: Preliminary results of analyses conducted by the National Oceanic and Atmospheric Administration (NOAA, 1984) indicate a considerable input of oil into east coast waters from the operational discharges of tank ships. This oil input, resulting from normal ship operations (bilge water pumping, tank cleaning, and ballasting), was estimated for 1979 to be in excess of 4.3 million gallons for the east coast area 3 to 400 mi offshore. It appears that, for most years, the total input into east coast waters (3 to 200 mi offshore) far outweighs that resulting from accidental spills. However, the concentration of surface oil from these operational discharges is estimated to be relatively small and not varying substantially among seasons. The greatest concentration of dispersed and weathered oil from operational discharges expected to be found 3 to 200 mi offshore is only slightly greater than 0.1 gallons per sq mi. The focus of concern in regard to these operational discharges is in relation to potential chronic and long-term impacts (NOAA, 1984).

Resuspension of Sediments: Disturbance of sediment, as primarily related to pipe burial, would cause resuspension of sediment, which in turn would temporarily affect water quality by increasing levels of suspended particles. The magnitude and extent of any increase in turbidity would depend on hydrographic factors operating at the time of installation, on the duration of activity, and on the type and grain size of the bottom materials. Suspended sediments would be dispersed and transported in the prevailing current direction.

Pipeline burial could also resuspend toxic metals, pesticides, or other organic or inorganic compounds if a sludge or chemical waste dumpsite were traversed. However, pipeline routing emphasizes avoidance of such areas.

Oil Spills: The most severe impacts on water quality are generally associated with large (> 1,000 bbl) acute oil spills as may be caused by a well blowout, tanker or platform accident, or a major pipeline break. However, smaller accidental spills (usually < 50 bbl), often associated with routine operations such as fuel transfer, are much more likely to occur.

Both large and small spills will affect water quality to some degree. The extent of the impact depends on the actual behavior and fate of the oil in the water column (e.g., movement of oil and rate and nature of weathering) which in turn would depend on the oceanographic and meteorological conditions present at the time.

A large oil spill at the water surface may result from a platform accident (e.g., platform blowout) or leakage from a tanker accident. Subsurface spills could occur from pipeline failure or a wellhead blowout. Most of the oil from a subsurface spill would likely rise to the surface and would weather and behave similarly to a surface spill. However, some of the subsurface oil may also get dispersed within the water column, as in the case of the IXTOC I sea-floor blowout (Fiest and Boehm, 1980) and possibly form a temporary subsurface plume--this being dependent on the density stratification of the water column and on temperature and salinity gradients.

The impact on water quality in the deeper, open ocean areas by a large, acute spill could be initially severe although likely temporary in nature. Physical oceanic processes would assist in breaking up the resulting oil slick and would contribute to weathering the oil, with photochemical oxidation and biological degradation aiding these processes. If an oil spill occurred within the inner or middle shelf area, or if oil from a deeper area were carried onto the shelf and toward the shallower coastal areas and embayments, the effects on water quality may be considerably more serious. Oil, in this case, would be more likely to get dispersed throughout the water column, may get entrained in suspended particles and bottom sediments, and possibly re-released into the water column from the movement of sediments by physical forces such as tides, currents, and waves.

Gas Line Break or Leakage: A gas pipeline leak or break is not regarded as posing a substantial threat to water quality. The natural gas released results in an increased level of light-molecular-weight hydrocarbons (C2 to C5) which would likely rise quickly to the surface and be released to the atmosphere. Some localized disturbance of sediment may temporarily increase water column turbidity and some liquid hydrocarbons, commonly associated with deposits of natural gas, may also be released.

Impacts Specific to the North Atlantic Planning Area: The most serious impact to offshore water quality within the North Atlantic Planning Area would likely result from a large (> 1,000 bbl), acute oil spill which may occur as a result of a tanker or platform accident, a well blowout, or a major pipeline break. For the proposed action, which includes 2 sales, it is assumed that only 1 oil spill of greater than 1,000 bbl would occur within the planning area (Table IV.A.4.a.1).

A large spill occurring within the Georges Bank crest area may result in a moderate level of water quality impact. In this case, elevated levels of the spilled oil (petroleum hydrocarbons) and weathered products may get dispersed throughout the shallow (<60 m deep) and turbulent area and be trapped within the gyre system for weeks before being transported off the Bank at one of the exit areas described by Houghton et al. (1981). Also, a high impact may be expected if a large spill occurred close to shore and the oil was tied-up within a low energy regime having poor circulation as in an embayment. However, most of the planning area is of an open ocean type with good circulation such that a large oil spill would likely be quickly degraded and the effects would be temporary, resulting in a low overall impact.

Local water currents and depth would greatly influence the fate of the estimated 601,500 bbl of drill muds and 133,800 bbl of drill cuttings which would be discharged by the proposed action. Generally, however, because of the relatively small volume of the drilling discharges compared to the large volume of receiving water, the predominantly rapid settling and dispersion of the discharges to background levels, and the spacing of discharges over a large area and long period of time (approximately 10 years), impacts on ambient water quality are considered to be low. Results of sediment trace metal sampling conducted during the Georges Bank Monitoring Program have demonstrated that the high energy of the Georges Bank environment tended to rapidly disperse drilling discharges (Bothner et al. 1983; 1985). Also, only those muds designated by U.S. EPA to be environmentally acceptable, as determined by bioassay test results, can be discharged on the OCS. The anticipated low impact to water quality from drilling muds and cuttings by the proposed action is in agreement with the general conclusion of minimal environmental risk determined by the National Research Council Marine Board study (NRC-MB, 1983).

Discharged formation waters (39.2 million bbl), which would be released over an approximate 25-year period, would be diluted rapidly and ultimately lost in the large volume of receiving water. Depending on hydrographic conditions, background levels of trace metals would be reached within a few hundred meters. The hydrocarbon content of discharged formation waters would be within U.S. EPA's prescribed effluent limits [the concentration of oil should not exceed an average 30-day concentration of 40 mg/l (40 CFR 435)].

Minimal impacts are expected from the discharge of domestic wastes and sanitary wastes, and from discharge of low levels of oil from such sources as deck drainage. These discharges are regulated by the U.S. EPA through the NPDES permit requirements and are quickly diluted to ambient levels in the receiving waters.

An increase in levels of suspended sediments and turbidity as a result of gas pipeline burial or breakage would be a local and temporary phenomenon. Operational discharges of oil from ships would not substantially affect water quality in that only a limited increase in shipping by oil tanker is associated with the proposed action. Also, recent stricter regulations now address discharges from vessels, (e.g., discharges are permitted only 50 mi beyond land).

CONCLUSION: A low, overall impact on water quality is anticipated from the proposed action (see Appendix A for impact level definitions). Discharge of routine effluents such as drill muds and cuttings and formation waters and the action of gas pipeline burial or breakage would result in generally localized and relatively minor water quality perturbations. Although a large accidental oil spill could cause a severe alteration of ambient water quality, this is likely to be temporary.

CUMULATIVE IMPACTS: When all oil spill sources are considered, the total expected number of large (> 1,000 bbl) oil spills within the North Atlantic Planning Area over a 30-year period is calculated to be 2.90 (Table IV.A.4.a.2) or, for impact analysis purposes, assumed to be 3 oil spills. Most of the oil spill risk is associated with tanker transport of imported (foreign) oil; this accounting for 1.56 of the total number of spills (Table IV.A.4.A.2). The remaining risk is attributed to domestic tanker transport and to OCS oil and gas activities, including the proposed action.

Under a cumulative case consideration, the total OCS oil and gas exploration and production activities within the planning area would result in a substantial increase in the volume of routine discharges (drilling muds and cuttings, formation waters, domestic and sanitary wastes, and deck drainage). Compared to the proposed action alone, this increase may be as much as 5-fold for some of these discharges. However, the total volume of these materials would still be small compared to the large volume of the receiving water. These materials would be rapidly dispersed/diluted within a geographically large area and spaced over a long (possibly 30-year) period such that the impacts on water quality, from these discharges, would be low and temporary in nature.

Operational oil discharges (discussed earlier in this section) from tankers constitute a large total oil input into east coast waters. However, the greatest concentration of dispersed and weathered oil from operational discharges expected to be found 3 to 200 mi off the east coast is only slightly greater than 0.1 gallons per sq mi (NOAA, 1984-preliminary results). Thus, the overall impact to water quality from these discharges seems low.

Five active coastal dredged-materials dumpsites are located within the North Atlantic Planning Area (discussed in Section III.A.1.a.(6)--Ocean Dumping). The impact on water quality from these U.S. EPA-approved dumpsites is uncertain since most of these sites have "interim" status, meaning that environmental studies for determining impact have not been completed.

CONCLUSION: A low impact on water quality is anticipated when the cumulative effects of all actions are considered. Although the assumed number of large accidental oil spills is increased from 1 (proposed action only) to 3, the alteration of ambient water quality is still likely to be of a temporary nature.

(ii) Onshore

Onshore water quality degradation will occur as a result of increased non-point and point sources of pollution associated with the construction and operation of onshore facilities supporting the North Atlantic Planning Area OCS activities.

Runoff from construction and operation of onshore support facilities constitutes a non-point pollution source. The construction of 1 new gas pipeline (and associated landfall) and 1 new gas processing plant will likely cause increases in surface runoff to nearby streams and rivers. This runoff would likely contain increased levels of suspended solids and heavy metals. Non-point source impacts may be minimized by controlling erosional effects generated within construction site boundaries, with several of the adverse impacts being localized and prevented from having offsite impacts to water bodies in the vicinity of these activities. Increases beyond normal background levels would be temporary and of a limited duration.

Increased effluent discharges will occur through point sources related to oil and gas operational support activities, primarily the 1 new gas processing facility. Waste-water discharge from a plant would include chemicals such as chromate, zinc, chlorine, phosphate, sulfide, and sludge conditioners, as well as oil and grease (NERBC, 1976). Point source discharges, however, will be subject to Federal and State water pollution control regulations and permitting; thus, potential adverse impacts can be mitigated.

No other new support facilities (e.g., refinery, pipe-coating yard, platform fabrication yard, marine terminal, marine repair and maintenance yard, and support bases) are anticipated for this proposed action.

CONCLUSION: The overall impacts to onshore water quality are anticipated to be low.

CUMULATIVE IMPACTS: Sources which may cause degradation of onshore water quality in the North Atlantic Planning Area, in addition to those associated with the proposed action, are diverse and numerous. These sources can be broadly categorized as intentional point (or pipeline) discharges, non-point discharges, and accidental discharges. The following discussion of these sources which may cumulatively affect onshore and nearshore water quality has been taken from NOAA's National Marine Pollution Program Plan (NOAA, 1981).

The major intentional point source discharges of waste materials into inshore and coastal areas come from sewage treatment facilities, industrial facilities, and electric-generating facilities. These pipeline discharges are regulated by the U.S. EPA through the National Pollutant Discharge Elimination System (NPDES). In 1979, more than 5,000 NPDES permits were held for ocean outfalls in coastal counties. The effluent from the industrial and sewage treatment facilities may contain, even after treatment, substantial quantities of synthetic organics, heavy metals, suspended solids, oxygen-consuming materials, and nutrients; sewage effluents may also contain fecal coliforms and potentially pathogenic microorganisms. Power plant cooling water discharges may be elevated in temperature and have increased chlorine levels.

Non-point source pollution occurs when runoff enters a body of water carrying with it pollutants from the land, such as petroleum hydrocarbons and lead from parking lots, pesticides and nutrients from residential lawns or agricultural fields, pathogens from faulty septic systems, or toxic materials from industrial areas (e.g., copper from a dry-dock hull-sanding area). In many areas the pollution from non-point sources is increased by the presence of coastal facilities and, in most regions, non-point source pollution accounts for a major portion of the contaminants that enter coastal waters. In contrast to the significant progress made during the 1970s in controlling industrial treatment facilities, progress with non-point sources is negligible (CEQ, 1980).

Accidental discharge of oil and hazardous materials into water bodies may occur during loading and unloading operations in ports and harbors, pipeline leakage, equipment failures, and spills from land vehicles and storage facilities onshore. The operation of some coastal facilities can result in large accidental spills or chronic unintentional discharges into coastal waters. For example, it has been estimated by Richardson et al. (1985) that, on the average, each fueling of a pleasure craft at a marina results in the spillage of a fluid ounce of gasoline or diesel fuel (NOAA, 1981).

In general, the onshore and nearshore water degradation in the North Atlantic Planning Area is associated with areas of heavy urban and industrial development; for example, continued estuary modification presents marine pollution problems in Boston, Providence, and Portsmouth. The proposed action represents one of many onshore impact-producing agents in the North Atlantic Planning Area and as such represents a very small portion of the cumulative impacts on water quality.

CONCLUSION: The cumulative impacts on water quality, including effects from actions not related to the proposed action, are anticipated to be moderate overall; localized high impacts may occur in the heavily urbanized and industrialized coastal areas.

### (b) Impact on air quality

Air pollutants are emitted from OCS facilities in the form of carbon monoxide (CO), total suspended particulates (TSP), sulphur dioxide (SO2), nitrogen oxides (NOx), which form NO2, and volatile organic compounds (VOC), which form ozone. Although nearly all OCS operations will result in some emissions of all of these pollutants, certain types of activities are responsible for the majority of emissions.

Power-generation equipment (such as gas turbines and diesel engines needed to run drilling and pumping operations) generally produces the largest amount of pollutants from OCS facilities, with NOx normally the pollutant emitted in the largest amount. The amount of all pollutants produced depends on the operating characteristics of the engine, such as size, type, period of use, and the type of fuel burned. Diesel engines produce the largest amount of emissions of pollutants; gas turbines emit lesser amounts.

If oil production is transported to shore by barge or tanker, large amounts of VOC can be emitted by the displacement of hydrocarbon vapors during barge loadings. Vapor remaining in the hold from prior shipments are pushed out into the atmosphere as the hold fills with oil.

The development scenario for this action assumes that natural gas would be transported via pipeline to an onshore gas processing and treatment facility possibly in southeastern Massachusetts. Such a facility would be individually designed for the particular gas stream that it processes. The type and magnitude of air emissions are determined by the volume of gas processed, the composition of the gas stream, plant design, and choice of pollution control equipment. If the gas stream contains a high concentration of hydrogen sulfide, H2S (i.e. "sour gas"), the "sweetening" process will result in a large amount of SO2 emissions. SO2 emissions resulting from the processing of "sweet gas" (low H2S content) are normally not a problem. Other potential pollutants from gas plants include nitrogen oxides, particulates, carbon monoxide and other hydrocarbon gases. A typical gas plant's emissions may include

| | (tons/year) |
|---|---|
| NOx | 1,590 |
| SOx | 221 |
| CO | 56 |
| particulates | 36 |
| hydrocarbons | 24 |

The 1977 Clean Air Act Amendments require all areas of the country to be categorized according to their National Ambient Air Quality Standards (NAAQS) attainment/non-attainment status for specified pollutants. Also, States have been required to submit to EPA for approval State Implementation Plans (SIPs) for attaining compliance with NAAQS. Each of the North and Middle Atlantic States where onshore sale-related facilities could be located have approved or conditionally-approved SIPs. Coastal areas that are not in attainment for primary or secondary standards within these States are indicated in Table III.A.4-2 in the FEIS for Sale No. 111.

Facility siting must also comply with Prevention of Significant Deterioration (PSD) provisions. Under these PSD provisions, areas are designated by EPA as either Class I, pristine areas such as national parks and wilderness areas which accommodate no industrial growth, or Class II, where moderate growth is allowed and which includes all other areas. Class III allows fairly intensive industrial development. The Brigantine National Wildlife Refuge in coastal Atlantic County, New Jersey, Acadia National Park in Maine, and the Swan Quarter National Wilderness area on the Pamlico River in North Carolina have been classified by EPA under the PSD system as Class I areas, thereby precluding them from any industrial activity. The areas analyzed in previous EISs as potential sites for a gas processing and treatment plant (e.g., vicinity of New Bedford, Massachusetts) are far removed from these Class I areas.

Facilities used for the exploration, development, and production of oil and gas in OCS waters are subject to DOI air quality regulations (30 CFR 250.57). Examples of facilities include exploratory drilling vessels, production platforms, and pipelines. During production, multiple installations or devices will be considered to be a single facility if the installations or devices are directly related to the production of oil or gas at a single site. Any vessel used to transfer production from an OCS facility will be considered part of the facility while it is physically attached to the facility. Crew boats, supply boats, and tankers while in transit to or from OCS facilities are not regulated by the DOI air quality regulations. However, any air emissions from a tanker while connected to a production platform or an oil or gas transfer mooring system in the OCS-activity area are covered. Additionally, pile driver barges or other construction-related vessels are covered while at platform or pipeline.

The air quality regulations set up by DOI specify emission exemption levels. If a source exceeds the exemption level, air quality modeling is required to determine whether it would significantly affect onshore air quality. The highest annual total amount of emissions from the facility for each air pollutant is compared to an emission exemption amount. This exemption level is based on distance from shore. Exemption levels are established for carbon monoxide (CO), nitrogen oxides (NOx), sulfur dioxide (SO2), total suspended particulates (TSP), and volatile organic compounds (VOC). Current and planned facilities with projected emissions below these levels are exempt from further regulatory requirements, unless the facility, individually or in combination with other facilities in the area, would significantly affect the air quality of an onshore area [30 CFR 250.57-1(j)]. The exemption level for CO is E = 3400 D2/3 where E is the emission exemption amount expressed in tons per year and D is the distance of the proposed facility from the closest onshore area of a State in statute miles. For TSP, NOx, SO2, and VOC, the exemption level is E = 33.3 D. The exemption levels apply to any offshore installation and related storage and processing facilities.

For any facility with projected emissions above the exemption levels for any pollutant other than VOC, an approved air quality model must be used to determine whether projected emissions from the facility would result in significant air quality impacts onshore. If such projected emissions are above the DOI significance levels, the applicant would be required, as a minimum, to apply Best Available Control Technology (BACT), an emission limitation based on maximum degree of reduction considering energy, environmental, and economic impacts.

Any source with VOC emissions above the exemption level is considered to significantly affect the air quality of an onshore area for VOC. Emission reductions would be required through the application of BACT [Section 250.57-1(g)(3)].

If projected emissions from an OCS facility, except a temporary one, significantly affect onshore air quality of a non-attainment area (designated region in which pollution levels do not meet Federal ambient standards), the emissions shall be "fully reduced." "Fully reduced" means that the lessee's net emissions increase must be reduced to zero. This shall be done through BACT, and if additional reductions are necessary, through the application of additional emission controls or through the acquisition of offshore or onshore offsets [Section 250.57-1(g)(1) and 250.57-1(g)(3)]. The projected emissions of any air pollutant other than VOC from any facility which significantly affect the air quality of an attainment or unclassified area shall be reduced through the application of BACT [Section 250.57-1(g)(2)].

The projected emissions for future facilities are listed by lessees in their Plans of Exploration or Development and Production or accompanying Environmental Reports. The exact information required is contained in 30 CFR 250.34-3.

CONCLUSION: A low level of impact on onshore air quality is possible from proposed OCS activities in the planning area.

CUMULATIVE IMPACTS: Resource estimates in the cumulative case for the North Atlantic Planning Area reflect more than a five-fold increase over the base case. Commensurate increases can be expected in OCS activities and resultant pollutant emissions. However, OCS facilities and activities would still be required to adhere to the DOI air quality regulations, and, when applicable, the State Implementation Plans (SIPs) promulgated under the Clean Air Act Amendments of 1977. Non-OCS-related activities such as increasing industrial activities, automobile emissions, and urbanization may also contribute to air pollution problems over the next 20 to 30 years. A variety of measures such as the SIPs mentioned above and automobile inspection and maintenance programs should aid in controlling these emission sources. Recent trends on a national basis have indicated a fairly steady decline in major pollutants such as SO2, CO, NO2, and particulates. This decline has not been conclusively demonstrated for ozone which may remain as a pervasive pollution problem for the forseeable future. Available data indicate that the affected states of the North Atlantic Planning Area reflect trends essentially the same as those found on a national scale.

In summary, although an increase in air pollutant loads might occur in the cumulative case, various measures currently in place on the state and national level, combined with other controls such as DOI's air quality regulations for OCS activities should be effective in limiting or even reducing the overall adverse impacts upon air quality in the region.

CONCLUSION: Cumulative activities should not exceed a moderate level of impact on onshore air quality.

### (4) Biological Environment

#### (a) Impact on plankton

Plankton, which can be divided into phytoplankton and zooplankton, is found in any part of the north Atlantic area. Impacts on them may result from drilling discharges, formation water, and hydrocarbons. Under the proposed action, it is anticipated that the drilling of 44 wells will create 601,500 bbl of drilling muds, 133,800 bbl of cuttings and 39.2 million bbl of formation waters. Since the magnitudes of the potential impacts are directly related to the concentrations of the muds and cuttings, factors which will increase dispersion are important impact reducing determinants. The most important of these would be the magnitude and direction of currents within the water column and the water depth.

Approximately 90 percent of the particulate solids settle directly toward the ocean floor. The remaining 10 percent forms a surface plume from which a secondary plume may form if the material encounters a pycnocline or zone of neutral buoyancy in transit to the bottom. Drilling discharges resulting from the proposed activities in the North Atlantic Planning Area will be diluted to undetectable levels very close to the point of discharge. Any slight decreases in primary productivity resulting from the discharges are expected to be insignificant. The spatial and temporal variability of plankton in the marine environment is considered to be, along with the rapid dilution of drilling rig discharges, an important factor in why these potential impacts will be virtually undetectable.

Based on studies of the effects of crude oil on phytoplankton, it can be postulated that a drop in primary productivity levels would be anticipated in the immediate vicinity of an oil slick shortly after a large oil spill. Within a few days much of the highly toxic components would have evaporated and the algal community would be expected to begin rebounding. Areas outside of the zone affected by the highest hydrocarbon concentrations may actually experience increased productivity. Corner (1976) concluded that even when high concentrations of the hydrocarbons are used, the effects on plant cells are reversible.

Zooplankton exposed to oil spills can accumulate hydrocarbons both by direct ingestion of oil and by feeding on phytoplankton that have absorbed fractions of the oil. Small quantities of aromatic hydrocarbons can persist within certain zooplankters 34 days after exposure. Zooplankton response was tested to the water-soluble fraction of No. 2 fuel oil. When removed from the pollution source, 99.69 percent of the originally accumulated hydrocarbon was depurated within 17 days. Two extensive studies of zooplankton following major oil spills at sea were completed following the Argo Merchant and Amoco Cadiz incidents. Shortly after the spills, oil was found adhering to the cuticle and appendages of certain zooplankters and oil particles were found in the guts and fecal pellets of copepods.

The possibility does exist for small amounts of petroleum hydrocarbons to become available to higher trophic levels following a spill. The impact on plankton is expected to be minimal, however, based on the rapidity with which the highly toxic fractions are removed from the system and the short time span within which phytoplankton communities rebound and zooplankters depurate their small amounts of accumulated hydrocarbons.

CONCLUSION: A low level impact on plankton is expected as a result of the proposed action.

CUMULATIVE IMPACTS: Under the cumulative case an estimated 3,304,500 bbl of drilling muds and 733,300 bbl of cuttings may be discharged. No leases from previous sales exist in this area.

It is assumed that at least 1 oil spill greater than 1,000 bbl will occur as a result of the proposed action. Several non-related spills may also occur as a result of continued importation of foreign oil throughout the north Atlantic area. Effects are anticipated to be local and temporary. Immediate decreases in primary and secondary production can be expected for localized plankton communities immediately following a large spill. Reversal of this effect will begin as the most toxic and volatile components of the spill are removed. This rebounding of the affected assemblage along with replacement by populations transported into the area should occur rapidly following the onset of dissipation, weathering, cleanup, and transport of a spill.

Non-OCS drilling in Canadian waters is not expected to have an impact on regional plankton populations.

CONCLUSION: Cumulative impacts on plankton are expected to be low.

### (b) Impact on benthos

### (i) Intertidal

Under the proposed action for the North Atlantic Planning Area most OCS operational activities will occur beyond the States' 3 mi jurisdiction. When onshore sites are being evaluated for new or expanded uses, all facilities need to follow the necessary Federal, State, and local permit processes to insure that acceptable sites have been chosen and adverse impacts are mitigated as local and State laws require.

Intertidal benthos would be subjected primarily to mechanical perturbations (pipeline laying), physical hazards (smothering), and physiological toxic effects of spilled oil. The degree and duration of possible impacts would vary with coastal topography, season, and, if a spill occurs, the quantity and quality of oil reaching shore.

Large quantities of fresh unweathered oil reaching a rocky, high energy coastline could cover and smother resident benthos resulting in high local mortalities. Stranded oil, though, would be removed by high energy wave action allowing the area to recover within a relatively short period of time. Benthos in areas with less wave energy could be subject to coating by oil causing lethal or sublethal effects, and these low energy environments may act as long-term hydrocarbon sinks. Impacts on biota are generally toxic effects if hydrocarbons persist in the environment for a long time. Chronic impacts can be expected which would affect future generations when heaving oiling has occurred and no major cleanup effort is made.

The north Atlantic intertidal zone is predominantly a high energy, rocky coastline supporting a dense and diverse assemblage of benthic invertebrates. Resident sessile species such as barnacles are passive victims of smothering by the heavy oils. Mobile invertebrates can become immobilized by the oil and then are susceptible to either the toxic effects of hydrocarbons or falling prey to predators. Filter feeders such as mussels, cockels, oysters, and clams are likely to ingest and accumulate dispersed or sedimented oil. Tainting may affect some of these species, but following cessation of pollution, hydrocarbons in the tissue are reduced to low levels within 30 days (RCEP, 1981).

Gas pipelines are generally buried to prevent damage from anchors and fishing gear. Trenching soft soil, such as the sands in the north Atlantic, to a depth of approximately 2 m disturbs the sediments up to about 9 m on either side of the pipeline. Based on calculations in Gowen et al. (1980), up to 21,700 m3 of sand per kilometer of buried pipeline would be displaced and 19,000 m2 of sediment surface area per kilometer of pipeline would be directly perturbed.

Disturbances from trenching for the laying of approximately 10 to 40 feet of a gas pipeline through the intertidal zone is considered to be short term. Impact on intertidal benthic communities from 1 assumed spill will be dependent on several factors: size of spill, location of spill, type of oil, environmental factors, and coastal sediments. If the 1 assumed spill greater than or equal to 1,000 bbl were to occur close to the coast and were to contact the shore within 3 days, a severe reduction or obliteration of the local benthic populations could occur. Heavy oiling could result in smothering and unweathered oil could be toxic and result in sublethal and chronic effects.

The possibility though of oil reaching shore in sufficient quantity and in an unweathered condition is limited by the size of the planning area and the proportion of the area located near shore. The impacts from a spill which occurred further offshore (>50 miles) would be considerably less than a nearshore spill. With time and distance, less oil would reach shore and be less toxic because of evaporation, weathering, and degradation of the more toxic fraction.

CONCLUSION: Impacts to intertidal benthos from oil and gas activities are expected to be local and low.

CUMULATIVE IMPACTS: Proposed and known future oil and gas exploration, development and/or production activities occurring within the intertidal area are expected to be limited to one-time operational activities (e.g., laying of pipeline). Resources for the cumulative case are higher than the ones for the proposed action, requiring additional wells (+187) and platforms (+9). Assumed oil spills would increase by 2 with the highest source of spill attributed to tanker transportation. The majority of oil being transported would be imported foreign oil. No leases from previous sales exist. No known non-OCS activities are expected to have an impact on the intertidal area. Considering the size of the receiving area, the quantities of discharge, and the distance of most of the planning area from the intertidal area, only low impacts could be anticipated.

CONCLUSION: Cumulative impacts from oil and gas operational activities and other sources on intertidal benthos are expected to be low.

### (ii) Subtidal

Factors associated with the proposed action which have the potential to affect the benthic environment are the placement of a gas pipeline, the discharge of drilling muds and cuttings, and the release of hydrocarbons.

Approximately 400 miles of gas pipeline are expected to be placed under the proposed action. Using the numbers provided, approximately 14.1 km2 (3,484 acres) of sediment surface area would be directly perturbed. Though immediate local impacts would be high, they could be expected to be short-term. On a planning area basis impacts would be low.

The physical burial of non-mobile benthic organisms when drilling muds and cuttings are deposited directly beneath and very near the drilling rig has been shown to kill these organisms. The degree of impact of these discharges on benthic and demersal species is highly dependent on local environmental conditions (e.g., water depths, currents, wave regime, and substrate) and on the nature and volume of the discharges including cutting sizes, discharge depth, and discharge rate. In dynamic areas such as on Georges Bank, both in situ bioassays and benthic sampling have shown little evidence of effects on the infaunal and epibenthic communities greater than 100 m from a well site. Benthic communities less than 50 m from the well site will probably be buried by the material present in the rapidly settling portion of the discharge plume.

In the shallower portion of Georges Bank, the physical oceanographic dynamics are so strong that no prolonged accumulation of drilling muds or cuttings is expected. No drilling discharges were evident 3 years after the drilling of COST well G-1 located in approximately 79 m of water on the southern flank of Georges Bank. Physical alteration of the sea floor caused by the accumulation of muds and cuttings tends to revert to predrilling conditions at a rate directly proportional to the natural physical and biological processes affecting that area. For example, in less than 100 m of water, wind-generated and tidal currents as well as storm surge tend to resuspend and disperse drilling discharges very quickly.

The ocean currents in the shallower areas of the north Atlantic region have been shown to transport fine-grained sediments off Georges Bank with deposition occurring in the southern portion of the Gulf of Maine, the Mud Patch, and in deeper continental slope areas. Therefore, the 44 wells in the proposed action will not make a noticeable difference in the benthic communities on a regional basis.

The Lydonia Canyon Dynamic Experiment (Butman et al. 1982) was the first direct current and sediment study to examine a major canyon along that slope. Preliminary information shows that fine sediments are accumulating in the head of Lydonia Canyon. This has lead to the question of whether fine-grained drilling muds could be accumulating in the canyons. A significant increase in suspended solids could adversely affect sessile filter-feeding organisms such as corals and sponges known to occur in these areas. Additionally, certain commercially important species such as lobsters and tile fish are known to be present along the slope and in the canyons. Derby and Atema (1981) showed that low concentrations of drilling muds can inhibit chemoreception of the walking legs of lobsters. This in turn may disrupt feeding and reproductive behavior. Conditions in some canyon areas may allow the gradual, temporary accumulation of sediment when normal oscillary current velocities are low. In order to detect the potential for accumulation of drilling muds in canyon heads, a portion of the Georges Bank Monitoring Program examined stations along the shelf break and in Lydonia Canyon (Battelle, 1982 and 1983; Bothner et al., 1982). Information from these reports has shown no evidence for the accumulation of drilling muds and cuttings in the canyon heads from the Sale No. 42 exploratory drilling.

Several trace metals, including barium (Ba) and chromium (Cr) are known to exist in drilling muds. Samples collected near drilling sites have shown that post-drilling levels of trace metals were within pre-drilling background levels. In deeper waters of the slope and rise, current regimes are usually lower than that seen in shallower waters. Even with lower velocity currents, the increased trajectories through the water column will result in dispersal of drilling muds and cuttings over a large area of the ocean bottom. This is expected to minimize concentrations of these discharges and thus lessen the potential impact on the benthos.

An oil spill has the potential to affect subtidal benthic populations because oil can be advected into the sea floor at shallow depths (< 60 m) or sink to the sea floor in the deeper waters over the shelf, slope, and canyons. The amount of biological damage will depend on many factors including: 1) physical and chemical characteristics of the oil, 2) the amount of oil spilled, 3) environmental conditions such as sea state, temperature, and salinity, and 4) the biological characteristics of the organisms, including life stage, season, and its previous exposure to oil. Should oil be advected into the sediments or sink in an area of high bottom currents, it is unlikely that the benthos would be exposed to it for long time periods. As a result of the high energy regime, oiled sediments would be reworked and ultimately dispersed. Should oil sink in or ultimately be deposited in deep water, an effect on localized benthic populations is possible. It is unlikely, however, that these oiled sediments would be resuspended. Rather, continuing sedimentation off Georges Bank would result in covering oil-contaminated sediments.

First-stage lobster larvae are one of the forms of aquatic organisms most sensitive to oil. Capuzzo (1982) studied the effects of South Louisiana crude oil on larvae and juveniles of the American lobster (Homarus americanus) in a continuous flow-through system. Disruption in the energetics of larval development was observed with exposure to oil-seawater mixtures and with ingestion of oil-contaminated brine shrimp (Artemia nauplii). Recovery of larval and early post-larval stages was not immediate upon transfer to uncontaminated seawater, but the normal pattern of energy utilization was slowly restored. Post-larval lobsters were less sensitive to crude oil-seawater mixtures than the larval stages and no disruption of energetics was observed.

Chronic spills can change the nature of the benthic community to include more opportunistic species, the animals that easily invade disturbed habitats. Such a change in the benthic community could affect the physical nature of the bottom; for example, a reduction in the number of tube-dwelling animals could destabilize bottom sediments and promote scour. Changes in the benthic community also affect the animals that feed there. Haddock and flounder, among others, are bottom feeders on Georges Bank. The investigations of Andy _et_ _al_. (1978) in the North Sea have shown that changes in benthic fauna are strongly correlated with levels of hydrocarbons in the sediments. The uptake and effects of crude oil and components of crude oil have been extensively investigated during the last decade.

Neff and Anderson (1981) reported on investigations of the toxicity of four API reference oils to larval, juvenile, and adult stages of several estuarine and oceanic organisms. Basically, the crude oils were less toxic than the refined products and the larval forms were more sensitive to oil contamination than were mature stages. The latter was not always the case; adults of certain species of shrimp and polychaetes showed greater toxic effects than did their immature stages.

In addition to acute toxicity of petroleum and specific petroleum hydrocarbons to various marine organisms' life stages, Neff and Anderson (1981) reported on subtle sublethal responses such as changes in reproduction, development, and growth when treated with high concentrations of hydrocarbons. It is important to note, however, that in many cases these changes were greatly diminished and even reversed in a few hours or days after a study began. This corresponds to the volatilization of much of the highly toxic component of the hydrocarbons tested.

In deep waters, the quantity of oil reaching bottom will be reduced with time by evaporation, current dispersal, and microbial degradation. Particles will remain more buoyant in cooler waters while some hydrocarbons will settle to the bottom in zooplankton fecal pellets.

Therefore, because of the size of the planning area and the small amount of activity from the 2 sales occurring over approximately 25 years, benthic populations affected by OCS activities could be expected to recover within one generation.

CONCLUSION: A low level of impact on subtidal benthos is expected as a result of the proposed action.

CUMULATIVE IMPACTS: An estimated 3,304,500 bbl of drilling muds and 733,300 bbl of cuttings may be discharged as a result of the cumulative case. No leases exist from previous sales. Based on the size and depth of most of the receiving waters these quantities will be readily dispersed.

Assumed spills will increase by 2 predominantly as a result of continued importation of foreign oil through the north Atlantic area. The majority of the north Atlantic is deep water where oil would not be advected into the sediment. The benthos could be subject to sublethal effects if oil droplets reached bottom by adsorbing to particulets or through fecal pellets. Accumulations of such hydrocarbons would be small and widely spaced with only local effects resulting.

The effects of Canadian drilling may be similar to those identified for drilling in U.S. waters. Other non OCS-related activities such as catching methods of the fishing industry could effect subtidal benthos. Canyon walls, canyon bottoms, and benthos could be damaged by bottom trawls, lost lines and equipment, and the creation of an overload of sediments in the water column. Local impacts in the canyons could be high, but have a low regional effect. Therefore, because of the size of the receiving area and the time period of activity, impacts are not expected to increase noticeably from the proposed alternative.

CONCLUSION: Cumulative impacts on the subtidal benthos are expected to be low.

### (c) Impact on fish resources

The placement of the anticipated 2 platforms and 1 gas pipeline during oil and gas development in the north Atlantic is expected to pose little threat to the fish resources in the area. Impacts on the resources would be limited to the immediate area around the structure and primarily result in habitat modification. The major cause of habitat modification would be the burial of the gas trunkline, which would disturb up to 19,000 m2 of sediment surface per kilometer of buried pipeline (Gowen *et al*., 1980). Sedimentation down-current from the burial activity--the extent of which would be determined by certain *in situ* factors such as grain size and current velocity--would also occur but should only cause minimal direct impacts to the fish resources of the north Atlantic region. Because the majority of the fish community consists of benthically oriented species, secondary impacts resulting from the burial of prey items would also occur. Because of the local nature of the perturbations associated with pipeline placement, and the relatively small area involved when compared to the entire North Atlantic Planning Area, impacts are expected to be restricted to the loss of a few individuals and a slight temporary reduction of prey species. Natural recolonization and use of exposed structures as attachment substrate should mitigate negative impacts within 1 year. The most severe impacts resulting from the placement of oil and gas structures would occur in areas of limited extent which are necessary habitats for certain species. "Pueblo village" communities which are found in the shelf break/canyon head areas and the historic spawning areas of sea herrings (which have demersal eggs) would be examples of such habitats.

The discharge of materials from drilling rigs is not estimated to be a source of appreciable impact to the fish resources of the North Atlantic Planning Area. There are three basic types of discharges from drilling operations: 1) routine operational discharges (domestic waste water, sanitary waste, deck washings, etc.); 2) formation waters from producing wells; and 3) drilling muds and cuttings. The discharge of routine waste water is regulated by the EPA and OCS Order No. 7 and must fall within acceptable criteria [see section IV.B.1.a.(3)(a)(i)]. The resultant discharge is expected to cause little, if any, impacts to fish resources, and would be limited to the upper part of the water column in the immediate vicinity of the drill rig. Formation water (interstitial water that may contain up to 350 ppt of dissolved solids, is low in oxygen, and typically has temperatures of 30-40° C) could be discharged from producing wells at a rate of generally less than 1,590 m3 (10,000 bbl) per day. Field studies, however, have demonstrated that impacts are typically limited to the physical confines of the production rig and reach ambient levels rapidly (Galloway, 1981). Therefore, impacts resulting from formation water discharges should be extremely localized and not of concern.

The discharge of drilling muds and cuttings probably cause the greatest impact to fish resources of all the operational discharges. Typically, however, the severest impacts are restricted to the proximity of the well head and decrease with distance from the well. This is primarily because the drilling muds and cuttings are discharged directly at the sea floor during the initial stages of well drilling before the rise is installed. A cone of drilling solids usually forms during this period and may cover up to 744 m2 (8,000 ft2) of natural habitat with up to 1 m in depth of drilling solids. Fish resources, being highly mobile, would not be directly affected by the discharge, but secondary impacts such as habitat loss or prey reduction would be evident. Recovery of these secondary impacts is expected to proceed rapidly in the north Atlantic. Because of the high energy regime in most of the area, natural re-soring forces would resuspend, redistribute, and disperse drilling solids allowing recolonization of the affected area within 1 year (Bothner _et al_., 1983; 1985). In parts of the planning area with lower energy input -- such as the deeper waters -- the deposited drilling solids may persist for much longer periods. A series of exploratory drilling monitoring studies conducted during the 3 years 1981-1983 on Georges Bank in the north Atlantic region have concluded that no significant decrease in faunal density and distribution, or increase in body burden of hydrocarbons or trace metals, was evident as a result of exploratory drilling (Payne _et al_., 1985).

The accidental release of petroleum hydrocarbons in the north Atlantic area would cause the most severe impacts to fisheries of all the impacting agents. The severity and extent of the impacts would be highly variable and depend on a number of physical and biological factors. The three prime factors which would dictate the severity of impact would be the season, the location, and the spatial extent of the spill. Impacts to egg and larval stages would be expected to be more pronounced than impacts to juvenile or adult stages because of the former's lower toxicity threshold and lack of mobility. In addition, the majority of the recreationally and commercially important species have pelagic eggs and larvae, which would place these life stages in the upper water column where they would be in proximity to surface oil spills and elevated dissolved hydrocarbon levels.

The possibility of a severe impact to fishery resources resulting from an oil spill does exist under the 5-year proposal. However, based on the resource estimates and spill rates available, the probability of a spill of the magnitude necessary for a major impact (>10,000 bbl) occurring is very low. The most evident impacts resulting from the 2 lease sales in the North Atlantic Planning Area would be a slight change in distribution of bottom species because of the placement of structures and exclusion of commercial fishermen from the proximity of these structures.

CONCLUSION: The overall impact to north Atlantic ichthyofauna is expected to be moderate, with population declines in localized areas but lasting less than 5 years.

CUMULATIVE IMPACTS: The transport of petroleum products through the north Atlantic region continues to pose a substantial risk to fish resources. It is estimated that 2.05 spills of 1000 bbls or greater will occur as a result of domestic and foreign oil being transported into and through the area by tanker (Table IV.A.4.a.2). Other additive agents which may or do cause impacts on fish resources include commercial fishing, which has severely decreased most natural stocks of commercially important fish; destruction or modification of fish habitat by fishery techniques; and the potential Canadian oil and gas industry operations on the Northeast Peak area. It is estimated that the potential cumulative impact level is presently very high. The proposed action is not anticipated to increase this level.

CONCLUSION: The cumulative impact level, including the proposed action, is very high.

#### (d) Impact on marine mammals

##### (i) Pinnipeds

The harbor and gray seals are not endangered or threatened but are species of concern in the North Atlantic Planning Area. They could be vulnerable to several adverse effects should they come in direct contact with an oil spill. They may inhale or ingest oil or become fouled with oil when swimming or feeding. Oil can irritate the eyes of a seal. It can also inhibit other bodily functions or may even cause death. In the case of the gray seal, oil could wash ashore on its only known breeding grounds in the U.S. waters (i.e., Muskeget Island, Massachusetts) and pose a threat to any pups or adults in the vicinity. Adverse impacts from sounds produced during seismic exploration or from collisions with or disturbance from service vessel traffic are not anticipated. It is unlikely that service vessels will transit waters near the island.

##### (ii) Cetaceans

Whales and dolphins could be vulnerable to several adverse effects should they come in direct contact with an oil spill. These effects include skin and eye irritation, inhalation or ingestion of oil, and baleen fouling in the case of baleen whales. An oil spill could disrupt feeding activities by dispersing prey species affected by the degradation of water quality.

Exploration and drilling-related noise and activities may also have an effect on these animals.

Because the epidermis of the skin of all cetaceans is composed of viable (live) cells, cetaceans may be particularly vulnerable to the noxious effects of direct contact with spilled oil. However, according to Geraci and St. Aubin (1982), cetaceans suffer no significant skin damage from exposure to crude oil. Because cetacean skin is smooth and essentially hairless, the risk of an animal becoming coated with oil is extremely remote. It has been suggested that cetaceans may inhale oil through their blowholes should they surface in an oil slick. This seems unlikely as the typical breathing cycle of cetaceans involves an explosive exhalation followed by an immediate inspiration and abrupt closure of the blowhole. However, toxic petroleum vapors from spilled oil could be inhaled and might adversely affect the animal's circulatory and respiratory systems.

Ingestion of oil may pose a problem to some species of cetaceans. However, in a controlled laboratory study, Geraci and St. Aubin (1982 and 1985) found that at least one species of cetacean, the bottlenose dolphin, has the ability to detect and avoid crude and refined oils during both day and night conditions. Additional findings of the oil effects study suggest that bioaccumulation of petroleum hydrocarbons by free-ranging marine mammals can occur, possibly by inhalation or ingestion. Geraci and St. Aubin (1985) showed that oil has a relatively short-term impact on baleen function, with effects significantly reduced in 30 minutes and totally reversed in a few days.

If a large spill should occur, it could temporarily contaminate and/or reduce the food supply in the vicinity of the spill. Whales feeding in the area could either ingest oil by eating the contaminated prey or be forced to search for supplemental food sources beyond the vicinity of the spill. Because only 1 oil spill greater than 1,000 bbl is estimated to occur during the oil production life of the proposed sales, all cetaceans occurring in the region should have a low risk of contacting oil. Offshore oil exploration will cause an increase in ship traffic which may increase the possibility of collisions with cetaceans.

The response of cetaceans to low frequency sounds of the type which are likely to emanate from exploratory rigs, production platforms, or geophysical surveys may include a startle or flight response, hearing loss, auditory discomfort, and masking of sounds such as communication, echolocation, and foodfinding signals. Although low frequency sounds are known to travel great distances through water under optimum conditions, Gales (1982) estimated that the most likely range for the detection of OCS platform sounds in seas influenced by high levels of background noise from ship traffic and relatively deep water (characteristic of the planning area) is several hundred yards for baleen whales and somewhat less for toothed whales and pinnipeds. These findings suggest that sounds from the drilling of 44 wells over a 10 year period in such a large area will not have a serious disruptive effect on marine mammals in the North Atlantic Planning Area.

CONCLUSION: Oil and gas operational activities within the North Atlantic Planning Area should have a very low impact on nonendangered marine mammals.

CUMULATIVE IMPACTS: Under the cumulative case, oil and gas operational activities will produce 3,304,500 bbl of drill muds, and 733,300 bbl of cuttings. Because of the size of the area immediately receiving the discharges and the high dispersion rates, muds, and cuttings are not expected to pose problems for marine mammals. No leases exist from previous sales. An additional 2 oil spills of 1,000 bbl or greater could occur. The increase in assumed spills result primarily from the transportation of imported foreign oil through the North Atlantic Planning Area. The potential for vessels hitting marine mammals will also increase. Some marine mammals migrate in and out of the area and therefore could conceivably come in contact with OCS activity in other portions of their range (e.g., mid-Atlantic, south Atlantic). The effects of Canadian drilling may be similar to those identified for drilling in U.S. waters.

CONCLUSION: Cumulative impacts are expected to have a low impact on nonendangered marine mammals in the North Atlantic Planning Area.

### (e) Impact on coastal and marine birds

Seabirds could be exposed to several adverse or lethal impacts from OCS oil and gas exploration and development associated with the proposed action. These impacts can be broken down into direct and indirect effects. Direct effects are caused by actual contact with a spill and they include matting of plumage which can reduce flying and swimming ability, loss of buoyancy which prevents resting and sleeping on the water, and loss of insulation resulting in death by exhaustion. The severity of the impacts resulting from direct contact would depend upon many factors (e.g., length of exposure, water temperature, and physical condition of the bird). It is thought that some species are actually attracted to oil slicks because the slicks appear as calm-water areas or suggest concentrations of prey species. Oil ingestion and accumulation of toxic petroleum hydrocarbons can lead to reproductive failure and increased physiological stress which can reduce an animal's ability to survive. During the nesting season, oiled adults can transfer oil from their plumage to unhatched eggs or chicks, thereby reducing hatching and fledging success, respectively.

Indirect effects are adverse impacts that can alter a specie's habitat, prey availability, or cause a disruption of essential activities. Prey species in offshore waters could be dispersed or reduced following a large oil spill. The incorporation of crude oil into the sediments of a shallow bay, estuary, or wetland could contaminate that habitat and depress populations of prey species (primarily shellfish) for several years. Construction activities, service vessel and helicopter traffic, and platform noises could disturb or displace nesting, migrating, feeding, or resting birds both offshore and onshore.

Among the marine birds in the North Atlantic Planning Area, diving species and species that spend most of the time on the water's surface (e.g., loons, grebes, and cormorants) have a much greater risk of contacting oil. Because these birds have low reproduction rates and are very slow to replace lost numbers, oil spill mortalities could result in both short- and long-term adverse effects. Some investigators have predicted, using population growth models for seabirds, that the loss of a significant number of adults could result in a recovery time ranging from 5 to 10 years up to over 100 years depending upon the severity of the spill and the resiliency of the population. The number of oil spills greater than 1,000 bbl in volume assumed to result from the proposed action is 1. This low number suggests that marine birds should not be exposed to severe oil spill conditions as a result of the proposed action. The resiliency of each specie's population is variable; however, the numbers of birds observed in the region indicate that most species are relatively abundant. Abundant and healthy populations should recover quickly from any mortalities resulting from an oil spill. Therefore, it is very unlikely that an oil spill from the proposed action will occur and have a severe impact on seabirds inhabiting the planning area. The low level of support vessel traffic and activities associated with drilling operations are not expected to disrupt seabird behavior patterns (e.g., feeding and resting).

Routine discharges from production operations could degrade marine habitats. Small, chronic discharges of crude oil contained in formation waters may also pose an undetermined threat to the more pelagic species of marine birds. The actual volume of crude oil that could be discharged would depend on several factors (e.g., volume and petroleum content of formation waters). However, considering the size of the planning area (approximately 52.2 million acres), the assumed oil production life of the field (approximately 30 years), and the estimated number of production platforms (2), the daily discharge rate should not pose a serious threat to pelagic species.

Shorebirds and wading birds are coastal water birds that would be vulnerable to both direct and indirect effects resulting from an oil spill that reached shore. Unlike marine birds, shorebirds and wading birds spend very little time on the water's surface and would be less likely to become severely oil fouled and die. However, they could ingest spilled oil or transfer it to their nests resulting in physiological disorders or failure of the nest. Indirect impacts such as habitat degradation or loss of prey would probably result in the most noticeable impact on these birds because of the limited amount of habitat available to them. Shorebirds have been found to avoid contaminated areas and to concentrate in oil-free areas following a spill. If an oil spill occurred near shore as a result of the proposed action, it could pose a moderate risk of impact to coastal water birds. The extent of the impact would depend on the volume of oil spilled, location, the time of year, and the number and condition of birds affected. Service vessel and helicopter traffic, and onshore support facilities are not expected to affect these birds as no significant filling of wetlands or coastal habitats will be required to accommodate these OCS service vessels or support facilities.

Waterfowl would be particularly vulnerable to oil spill impacts during their spring and fall migrations through the planning area. The most susceptible waterfowl are the sea ducks which migrate and winter off the coast. These birds have been found to suffer severe losses in numbers from large nearshore spills. Because sea ducks concentrate at the entrance to and within the Delaware Bay, there is the probability that a tanker spill would affect these birds. In addition, support vessel and helicopter traffic could disrupt normal waterfowl activities but should not have a serious adverse effect.

A number of coastal parks and wildlife refuges that are important to marine and coastal birds and to a wide variety of wildlife in general exist in the planning area. Oil spill impacts would have significant adverse effects on the quality of these coastal areas. However, oil spill containment and clean-up equipment will be available to reduce or prevent losses to birds and their habitats. Some losses should still be expected if a spill occurs and reaches the shore.

The low number (1) of assumed oil spills indicate that it is very unlikely that the proposed action will pose a serious oil spill threat to coastal birds and their habitats. This low oil spill risk and the anticipated low level of related onshore development suggest that the proposed sales should have only a minor impact on coastal birds.

CONCLUSION: The activities associated with holding the 2 proposed OCS lease sales in the North Atlantic Planning Area by the proposed action should have only a very low impact on seabirds.

CUMULATIVE IMPACTS: Assumed oil spills in the Mid-Atlantic Planning Area are not expected to have a significant cumulative impact on marine and coastal habitats affected by oil and gas activities in the North Atlantic Planning Area. However, because of the wide-ranging and migratory behavior of most of the species occurring in the north Atlantic region, a spill in the Mid-Atlantic Planning Area could affect many birds. The cumulative effect of oil and gas activities in both the North and Mid-Atlantic Planning Areas could result in low mortalities of some marine birds with population declines possible. In addition, valuable marine and coastal habitats from Georges Bank to Cape Hatteras, North Carolina, could be degraded from exposure to a near-shore oil spill.

Impacts that are not related to exploration, production, and development activities but could contribute to a cumulative impact on avian resources include the loss of nearshore and onshore habitats from private and recreational development. This would pose a serious threat to wading birds and shorebirds in particular. Those species which migrate as far as Central and South America could be exposed to toxic substances that will inhibit reproduction. Industrial and sewage sludge wastes from designated ocean dumpsites could have an adverse effect, especially on marine birds, by degrading the ocean environment. Marine birds will also be exposed to assumed oil spills from oil imported into the North and Mid-Atlantic Planning Areas. However, transcontinental migratory species are protected and managed in accordance with international treaties. These treaties do provide a measure of protection to international migrants by requiring signatory nations to promote the conservation of these species.

CONCLUSION: The cumulative impacts from the proposed action and existing OCS lease sales in the North Atlantic Planning Area, in adjacent regions, and from other activities could pose a moderate threat to seabird populations inhabiting the lease area.

### (f) Impact on endangered and threatened species

#### (i) Endangered or threatened birds

The bald eagle is an endangered species which could be adversely affected if an oil spill reached shore. Should an eagle contact or ingest oil-contaminated food, several things could result: the eagle could be poisoned by the oil, it could develop sublethal physiological abnormalities, egg-laying could be inhibited, plumage could become oiled, or oil could be transferred to eggs, thereby reducing hatchability. These impacts are considered unlikely unless crude oil or oiled fish or birds wash ashore in the eagle's territory.

Endangered or threatened peregrine falcons could be adversely affected during their spring and fall migrations. Peregrines would be most susceptible to oil pollution when preying upon oiled seabirds. This could result in direct toxicity to the falcon, through oiled plumage, or sublethal physiological disorders. Because peregrines have been found as far as 300 mi offshore, oil spills from the lease area that do not approach shore could affect peregrines indirectly by affecting offshore prey species. Currently, an attempt is being made to reestablish breeding peregrines in several coastal areas of New Jersey and in the City of New York. Oil spills reaching these breeding areas would not only pose a threat to adult birds but also to their eggs and young, since the adults could transfer oil to their nest. However, laboratory studies by Pattee and Franson (1982) with a different species of falcon, the American kestrel (Falco sparverius), indicate that ingestion of crude oil poses little acute hazard to falcons. Because of the low level of activity, expected impacts are expected to be very low.

CONCLUSION: The proposed action is expected to have a very low impact on endangered or threatened birds.

#### (ii) Endangered or threatened sea turtles

It has become apparent, based upon empirical evidence and the preliminary results of current studies, that oil can have a harmful effect on sea turtles. The extent of this adverse effect is still being determined by an MMS-funded study (Study of the Effects of Oil on Marine Turtles, Contract No. 14-12-0001-30063). Preliminary results from laboratory tests indicate that turtles will strike at tar balls in an attempt to eat them; however, the number of strikes was found to decline over time. Acute exposure produced obvious distress in turtles within 24 hours. A mild-to-moderate skin reaction was also observed. However, all the turtles tested have survived and recovered well following the oil exposure. Although these results are preliminary and subject to change, they indicate that oil spills could have an adverse effect on sea turtle behavior and physiology. However, the likelihood that sea turtles in the North Atlantic Planning Area will be exposed to a sale-related slick is extremely small because only 1 spill greater than 1,000 bbl is assumed to occur in the planning area, as a result of the sales in the proposed schedule.

It is generally accepted that offshore platforms act as artificial reefs causing a large increase in biomass in their immediate vicinity. Such an increase will probably attract feeding turtles. Two production platforms are expected to be used to develop the field. If an oil spill occurs at a platform, turtles could be in the immediate vicinity and would likely be adversely affected. Furthermore, if members of the biological communities under the platforms accumulate the toxic materials and trace metals routinely discharged from the platform, the turtles can, through the food chain, ingest the toxins with the probable results being physiological disorders or death. Sea turtles can also be killed or injured by collisions with ships, a risk which will increase as a result of service vessel traffic. If platforms attract turtles as expected, the increase in vessel traffic will occur in areas where turtles may congregate.

Low-frequency deep seismic surveys may have a disruptive effect on sea turtles. The response of sea turtles to low frequency sounds from these surveys may include a startle or flight response, hearing loss, or auditory discomfort. However, considering the high ambient noise levels in the north Atlantic, low frequency seismic sounds should be detectable only within a few hundred yards of the sound source. In addition, sea turtle behavior and physiology suggest that these animals do not rely on sound to any significant degree to communicate or to locate food. Therefore, it is unlikely that sea turtles would suffer any significant adverse effects from seismic activity.

Of the five species of endangered or threatened turtles encountered in the North Atlantic Planning Area, the loggerhead and leatherback are the most frequently sighted species. These two species would be most vulnerable to an oil spill and other sale-related activities during the late spring, summer, and early fall seasons as these are their periods of peak abundance. For the remainder of the year, these turtles are essentially absent from the north Atlantic. Although some sightings of loggerheads and leatherbacks were made in the north Atlantic, CETAP data indicate that the nearshore and midshelf regions of the mid-Atlantic, principally areas in the New York Bight, contain the majority of sightings of leatherbacks and a high number of loggerheads. Therefore, an oil spill originating in the North Atlantic Planning Area and activities occurring in this area are unlikely to pose a threat to the leatherback or loggerhead populations. However, tanker traffic from the North Atlantic Planning Area is expected to transit to the Mid-Atlantic Planning Area. Should a tanker have a spill, the probability of a spill adversely affecting the turtles at sea would increase. Some mortalities could occur, but the impact on the whole population should not result in a serious adverse effect.

CONCLUSION: The proposed action should have a very low impact on sea turtles in the North Atlantic Planning Area.

### (iii) Endangered whales

The six endangered species of whales occurring in the North Atlantic Planning Area are described in Section III.A.2. Five of the six species appear to transit the planning area during migration periods. The humpback, right, sperm, fin, and sei whales have been observed feeding on several occasions or have been sighted in large numbers within the area boundaries.

In their latest Biological Opinion for the north Atlantic region (June 16, 1982; modification September, 1983, consultation for Lease Sale 82) the National Marine Fisheries Service (NMFS) concluded that oil and gas exploration activities conducted in identified preferred areas within the North Atlantic Region are likely to jeopardize the continued existence of the endangered humpback and right whales.

Humpback whales were observed in the planning area year-round with the greatest number of sightings occurring during the spring, summer, and fall primarily in the Great South Channel. Feeding activity and adults with calves were observed frequently in this area and in nearshore areas to the north and west. NMFS has identified these feeding areas as preferred areas. In addition, NMFS has determined that long-term exploratory drilling activities may have a serious effect on these whales by displacing them from their feeding grounds. An oil spill in the Great South Channel basin could temporarily reduce or disperse their principal prey (sand lance) and adversely affect adults with calves.

The humpbacks preference for nearshore waters (100 m or less) could preclude any serious adverse impact resulting from drilling activities on their population.

The right whale tends to concentrate and feed in the same general areas as the humpback with the exception of the waters off Montauk Point. Like the humpback, the right whale occurs in the area, primarily in the waters of the Great South Channel. However, the right whale is present in these areas for a shorter time period (spring to early summer) and then moves north into the Gulf of Maine. Breeding activity has been observed in the entrance to the Bay of Fundy which borders the northern boundary of the Gulf of Maine. NMFS has determined in their most recent Biological Opinion for the north Atlantic that the Great South Channel is a preferred feeding ground for the right whale and seismic survey activity conducted in the area while right whales are present is likely to jeopardize the continued existence of this species. However, the right whale would probably be exposed to the effects of seismic activities in the Great South Channel for only a limited period each year because the best available data on its distribution (CETAP, 1982b) indicate that this species concentrates in the Channel during the spring and early summer only.

An oil spill occurring in or entering the right whale feeding area could have a major impact on the whales, especially if it occurred during the spring or early summer. The types of impacts already discussed in the section IV.B.1.a.(4)(d) could result. Although an oil spill is not likely to lead to direct mortalities, it could reduce available prey (copepods) which are critical to migrating right whales ending a fall and winter fasting period. If the whales are unable to store sufficient food energy in the spring, they may not be able to successfully mate and reproduce that year, which would have an adverse effect on their recovery. Baleen fouling could occur because right whales often feed at the surface.

The blue whale has been drastically reduced from its former numbers and is now rarely seen in U.S. waters. They occasionally stray into the Gulf of Maine but are generally found in the Gulf of St. Lawrence and more northern waters. Therefore, it is highly unlikely that the blue whale will be affected by any activities resulting from the proposed action.

Sperm whales can be encountered most frequently in the area along the 1,000-m contour year-round, with highest numbers occurring from spring through fall. In their latest Biological Opinion (June 16, 1982; modification Sept. 1983) for the north Atlantic, NMFS determined that a portion of this sperm whale distribution should be considered a preferred area. In addition, sperm whales enter shallow shelf waters (inshore of the 100-m contour) restricted to the area south of Block Island to southeast of Nantucket Island during the fall season, apparently to feed on migrating squid. An oil spill could cause localized reductions in the availability of this food source. Because sperm whales may concentrate in the area of highest hydrocarbon potential, they will be more vulnerable to certain impacts related to OCS activities. Sperm whales do not typically feed on the surface. So it is unlikely that they would ingest floating oil while feeding. However, the physical presence of the drilling rigs and the sounds they produce may inhibit feeding activities. Tankers transporting OCS oil are expected to pass directly through the shallow shelf waters used by the sperm whale in the fall. Tanker accidents in the area could have a high risk of affecting these whales or their prey during the fall when they concentrate and feed in these waters. Sperm whales can exhibit a sleeplike behavior in which they float at the surface in a state of decreased awareness which could make them particularly susceptible to collisions with service vessels.

Fin whales could be exposed to impacts related to OCS activities on a year-round basis as this species and the sperm whale were the most commonly sighted large cetaceans in the area. Feeding adults and adults with calves were observed many times in the area. NMFS determined that these feeding grounds are preferred areas that are important to fin whales that fast or feed very little before reaching these waters. An oil spill could temporarily reduce available prey and adversely affect adults with calves. The effects of OCS tanker traffic on breeding whales are not known, although these activities may have disruptive effects.

The majority of sei whale sightings occurred along the southern margin of Georges Bank with very few sightings recorded in potential OCS tanker routes. The tendency for this species to skim the water's surface when feeding may make it particularly vulnerable to ingestion of spilled oil. Because sei whales are abundant in the area for only a limited time (spring), and critical calving activities apparently occur elsewhere during the winter, the threat of a serious adverse impact on this stock is unlikely.

All endangered whales exhibit some degree of migratory behavior. The results of the CETAP study suggest that the fin, sperm, humpback, sei, and right whales migrate into or through the area during late winter to early spring. The fin, humpback, and right whales tend to concentrate in the western half of the area (Great South Channel) while the sei and sperm whales are most prevalent along the southern margin of Georges Bank. The fall and winter migration is less clear but it appears these whales, except for the fin, move offshore into deeper waters in a more random manner throughout the region. These migratory patterns could expose the whales to oil and gas activities in the planning area on a regular basis. If the whales use the Gulf Stream as a migratory pathway as has been suggested, oil spills entering the Gulf Stream could have an impact on migrating whales. The low level of production activity (2 platforms) should preclude a major adverse impact on migrating individuals. Because the whales migrate over a relatively broad front (i.e., Continental Shelf or Slope), the physical presence of the rigs and the sounds they produce, combined with tanker traffic resulting from the proposed action should not have a concentrated effect on the animals.

An extensive amount of field data on the effects of geophysical surveys on endangered whales has been collected. To date, efforts have concentrated on the bowhead and gray whales. The bowhead and gray whales are both baleen whales, as are five of the six endangered whales in the Atlantic. The sperm whale is an odontocete that would respond to higher frequency sounds not generally used in seismic surveys. The bowhead is the closest living relative of the right whale, the most critically endangered whale in the Atlantic. The study results of several investigators are explained in detail in the Final Supplemental Environmental Impact Statement for OCS Sale No. 70 (St. George Basin). In general, the results indicate neither deep nor high-resolution, geophysical surveys activities are expected to seriously affect baleen whales in Alaska. Direct injury such as physical impairment of hearing even at close range, is very unlikely. Subtle behavior responses (e.g., brief flight responses, changes in surfacing and dive times, and temporary changes in direction of movement) are possible, although only individuals close to the sound source should be affected. In addition, because of the high ambient noise levels and deepwater conditions found in the region, the response to seismic sounds should be even less in the north Atlantic than what was observed in Alaska. Therefore, seismic activities resulting from the proposed sale should have only a minor effect on whales inhabiting the North Atlantic Planning Area.

CONCLUSION: A very low level of impact on the sperm and sei whales is expected. However, if production activities are concentrated in the deeper (slope) waters of the area, these two species could experience somewhat greater impacts. Humpback and fin whales may experience a very low level of impact. Activities associated with the proposed action could have a high level of impact on right whales depending upon what amount of production and development activity occurs in the Great South Channel area.

CUMULATIVE IMPACTS: A spill in the Mid-Atlantic Planning Area is not likely to contact important habitats of endangered birds and coastal species in the North Atlantic Planning Area. However, because of the migratory behavior of the bald eagle and the peregrine falcon, these birds could contact a spill in the mid-Atlantic. In addition to impacts from sales in the North and Mid Atlantic Planning Areas, migratory peregrine falcons could even be affected by OCS activities in the South Atlantic Planning Area. The cumulative effect from all OCS activities in the Atlantic could result in a small number of birds becoming fouled with oil. It is unlikely that this should have a significant adverse impact on the population as a whole, but it may result in the mortality of some individual birds that at some time inhabit the North Atlantic Planning Area.

The fin, sei, sperm, humpback, and right whales together with the leatherback and loggerhead sea turtles occur to varying degrees in all three OCS lease areas bordering the Atlantic coast. These endangered or threatened marine species could be exposed to OCS activities over a major portion of their range. One oil spill in any region, together with all other OCS activities, could result in some adverse impacts, including the loss of a few whales and sea turtles, which could inhibit the return of each species to a nonendangered status. In the case of the right whale, the loss of any individuals could have a major impact on their populations.

Impacts that are not related to OCS activities but could contribute to a cumulative impact to all coastal species would include the loss of onshore breeding, migratory stopover, an over-wintering habitats from private and recreational development of coastal areas. The Arctic peregrine falcon migrates through Central and South America where it is exposed to toxic pesticides like DDT which can drastically reduce the reproductive capbilities of these birds. Tanker spills of crude or refined petroleum imports entering the region could pose a serious threat to peregrine falcon migratory stopover areas. The net effect of these impacts could inhibit the return of this species to nonendangered status or further reduce remaining populations.

Impacts that are unrelated to OCS activities but could contribute to a cumulative impact on sea turtles in the North Atlantic Planning Area include moderate to high mortality rates caused by commercial fishermen in the Gulf of Mexico along the southeastern coast of the United States. Also included are natural and man-induced predation on turtles and eggs on nesting beaches of all five species in the Gulf of Mexico/Caribbean Sea. In 1980, aproximately 1,850 sea turtle carcasses washed ashore on beaches in the south Atlantic region; presumably, the majority were killed in shrimp trawls (Federal Register, October 7, 1980). The three assumed spills over 1,000 bbl from petroleum imports may also contribute to the number of turtle mortalities. The cumulative effect of these impacts could result in additional mortalities and possibly population declines for all species and fewer sightings of sea turtles in the north Atlantic area. This would be especially detrimental to leatherback, hawksbill, and ridley sea turtles because of their low population sizes.

Impacts that are unrelated to OCS activities but could contribute to a cumulative impact on humpback whales in the north Atlanic area include the annual subsistence level fisheries for this species in Greenland (International Whaling Commission [IWC] quota of 8 in 1984-1985). Entrapment injury and mortality (17 killed in 1980) from inshore fishing gear along the Newfoundland coast is also a problem (Humpback Whales of the Western North Atlantic Workshop-New England Aquarium, Boston, Massachusetts, November 1721, 1980). No other species of endangered whales in the Western North Atlantic Ocean have huntable quotas set by the IWC, although illegal hunting of some species may take place. The small number of estimated spills over 1,000 bbl each from petroleum imports may disrupt cetacean behavior, reduce the food supply in a localized area, and may contribute to the death of some individuals. Canadian offshore oil drilling in the waters around Nova Scotia and Newfoundland also could affect endangered whales. The effects of Canadian drilling may be similar to those identified for drilling in U.S. waters. The cumulative effect of OCS activities and activities unrelated to OCS operations could result in a low number of additional whale mortalities which could limit the number of sightings in the North Atlantic Planning Area and inhibit the return of these animals to a nonendangerd status or may even increase the risk of extinction.

CONCLUSION: The cumulative impacts from other sources and from the proposed oil and gas exploration, production, and development activities in the North Atlantic Planning Area could have a moderate impact on most endangered or threatened birds, coastal species, sea turtles, and whales, and a high impact on right whales.

### (g) Impact on estuaries and wetlands

The types and extent of impacts that could occur in sensitive coastal estuaries and tidal wetlands from an oil spill are quite numerous and potentially severe because of the complexity or biologically fragile nature of these ecosystems. Should an oil spill enter or occur in a bay or estuary, the immediate result would be a temporary drop in water quality that would have the greatest effect on planktonic organisms in the water column. Oil would probably strike the shoreline and become incorporated into bottom sediments. Incorporation of oil into the sediments will retard degradation of the oil and could cause contamination to remain for up to 10 years, which can cause serious impacts on benthic organisms. Water flow patterns in estuaries tend to make them act as nutrient and pollutant traps, thus may limit spilled oil from being flushed from the system. This could increase the amount of exposure to spilled oil for many estuarine plants and animals. The effects of an oil spill on the many resources that use the areas, such as bird species, commercial fisheries and shellfish, and other aquatic invertebrates, may be severe.

Wetland vegetation bordering estuarine shorelines and salt marshes could be adversely affected by an oil spill. Generally, oiled vegetation dies back but the roots and rhizomes remain viable when a spill is not too severe. Chronic pollution will have more serious effects. The impacts of oil on marsh plants is further dependent upon the season (growing versus dormant) in which a spill might occur. Damage would be greatest during the spring and summer growing season. Because aquatic vegetation plays such a vital role in maintaining the stability of estuarine and marsh ecosystems, the permanent loss of vegetation would result in decay of these systems.

In Narragansett Bay, three islands and their surrounding waters have been designated an estuarine sanctuary. Although an oil spill in this sanctuary would jeopardize most of the existing sanctuary uses and wildlife resources, it is extremely unlikely that an oil spill would penetrate into the bay far enough to affect the sanctuary. Service vessels operating out of Davisville, Rhode Island are not expected to transit sanctuary waters.

The beach-dune region of the north Atlantic consists of a narrow strip of land essentially lining the entire north Atlantic coast, except for Maine. An offshore oil spill contacting a beach could destroy dune grass (needed to stabilize the beach), saturate the sand, and require mechanical removal of contaminated sands. The removal of sand by heavy equipment would contribute further to the destruction of the beach-dune area. The degradation or temporary loss of a beach-dune area would have the greatest effect on terrestrial and avian species that could not move to adjacent "clean" areas. The vegetation may take several seasons to recover. Spilled oil could penetrate the sandy sediments and threaten underground water supplies. However, most impacts (e.g., oil-fouled beaches and wetlands) will tend to be relatively short-lived because of the natural breakdown of oil in the marine environment and the oil spill containment and cleanup operations required under OCS Operating Order No. 7.

One gas pipeline is projected to bring gas ashore. This pipeline would probably have its landfall in a sandy beach area, proceed inland, and terminate at a gas facility. Impacts on beach areas originate from trench excavation through unstable sands and sediments that are prone to rapid erosion when disturbed. However, the sides of the trench are usually retained by sheet-piled coffer dams to avoid any serious erosion problems during trenching. Impacts are further mitigated because of the short period needed for construction (2 to 4 months) and the relative ease of refilling the trench (10 to 40 feet in width). Vegetation landward of the beach will be greatly disturbed or destroyed in the pipeline right-of-way (approximately 150 feet in width) during construction activities. Proper reclamation and management practices will be needed to reestablish vegetation in the operational right-of-way (40 to 50 feet in width). Woody and shrubby plants such as those found in the numerous small cedar swamps in the Rhode Island area and dune vegetation on Cape Cod would be permanently excluded from the right-of-way.

CONCLUSION: Adverse impacts on estuaries and wetlands are expected to be very low.

CUMULATIVE IMPACTS: Oil spills from the mid-Atlantic area are not expected to have a significant cumulative impact on marine and coastal habitats affected by OCS activities in the north Atlantic area. However, the cumulative effect of OCS activities from both regions combined could result in the degradation of several nearshore and coastal areas ranging from

Martha's Vineyard to Cape Hatteras, North Carolina. The impacts on these sensitive habitats will tend to be relatively short-lived because of the natural breakdown of oil in the marine environment and because of spill containment and cleanup operations required under OCS Operating Order No. 7. Toxic hydrocarbons that might become entrapped in bottom sediments or sink areas could pose a long-term (over 5 years) threat as oil trapped in sediments degrades very slowly and may be resuspended in the water column when disturbed. Oily sediments can have a deleterious effect on marine benthos.

Spills from transportation of imported crude oil and refined products are likely to occur in the north Atlantic area over a 30-year period. These spills, combined with a very high probability of impact, indicates that imported products pose a much more serious threat to coastal resources than do OCS activities alone. OCS and non-OCS spills should not be cumulative because oil transported by OCS tankers is expected to replace an equivalent volume of imported crude. In addition, private and recreational development will continue to pose a more severe threat to the remaining undeveloped areas in the region.

CONCLUSION: The present non-OCS activities in the North Atlantic Planning Area represent a potential high level of impact to sensitive coastal areas. The proposed action will not appreciably modify this level.

### (h) Impact on areas of special concern

Submarine canyons are areas which would be of particular concern in the north Atlantic. The mechanical damage that results from the placement of structures such as pipelines, well complexes, platforms, and well heads is highly localized. Individuals of benthic infaunal and attached epifaunal populations may be destroyed, but the population as a whole would be unaffected. The primary reason that canyon areas demonstrate increased biological productivity is that they afford attached epifaunal species an increased amount of attachment substrate. Therefore, the adverse impact resulting from destruction of these species is expected to be mitigated within 1 year, as these species use the structures as substrate. The impacts on infaunal species would remain at the same level, or increase slightly, if the structures cause changes in near-bottom currents that modify the habitat or niche spaces in the immediate vicinity of the structures. In either case, the overall impact to infaunal species is expected to be minor in canyon areas. The greatest impact resulting from mechanical damage would occur in the "pueblo village" areas of canyon heads. These areas are extensive burrow systems that support a number of species such as tilefish, lobster, red crab, and cancer crabs. They would be highly susceptible to mechanical damage resulting from structure placement. It is not known at this time if placement of these structures would cause long-term local impacts, or if these structures may act as artificial reefs, mitigating adverse impacts after a short period of time. The placement of oil and gas structures in canyon areas may increase the turbidity, affecting filter-feeding organisms downcurrent from the site. Because the turbidity is caused by suspended natural sediments, short term, and localized, minor impacts to the canyon areas are expected. However, individual organisms may be damaged or destroyed.

Drilling discharges are basically of two types: formation waters, and drilling muds and cuttings. Impacts on canyon areas from formation water discharges are considered to be nonexistent. These discharges are in the surface waters far above the canyon area and are diluted to ambient levels within a short distance of the discharge pipe.

The second type of discharge, drilling muds and cuttings, can also be placed into two categories. The first is the chronic discharge of muds and cuttings while the well is drilled (after the riser is attached) and which typically occurs at or close to the water surface layer. The second category is the acute bulk discharge, which may occur in a number of ways. A source of acute bulk discharge occurs during as much as the first 2,000 ft of drilling a well (spudding in) when the marine riser is not attached. This means that the mud that is pumped down the middle of the pipe string and is used to carry the cuttings out of the well hole cannot be recirculated back to the drill rig. This results in about 1,500 bbl of mud and 1,500 bbl of cuttings being released directly at the sea floor. Also, if a semisubmersible drill rig or a drill ship is forced off station, and the riser must be detached from the wellhead, a bulk discharge of the mud in the riser will occur directly at the sea floor. Another source of acute bulk discharge is any drill mud which is in the circulating system at the end of drilling the well and which is discharged in bulk at the surface discharge pipe.

Chronic discharges of muds and cuttings are expected to pose little threat to canyon systems. As this discharge occurs, the drilling muds and cuttings separate into two plumes. Approximately 10 percent of the discharge (typically the smaller mud fraction) forms a surface plume which becomes highly dispersed and is not evident at greater than 1,000 m from the rig. This surface plume is not expected to cause any impact to the canyon areas. The remaining 90 percent is hypothesized to form a slurry, which convectively descends to a depth where it becomes neutrally buoyant. The heavier particles such as drill cuttings are expected to separate out of the plume at this time and be deposited on the bottom in the vicinity of the drill rig. As the ambient currents in the area carry the plume away, the particles remaining would "rain" out of the plume in order of descending size (following Stokes Law) and be spread over the canyon area as the plume dynamically collapses. In the water depths of the north Atlantic canyons, the drilling muds are expected to be highly fractionated and dispersed. However, the drill cuttings which would be deposited around the drill site may cause changes in the sediment granulometry of the area. Because the canyons in the north Atlantic appear to be areas of deposition of fine particles (low energy), these changes may persist until sedimentation covers the cuttings, returning the substrate to the natural state. The impacts as a result of this may be long term; however, they are expected to be very local and affect primarily the infaunal species. Conversely, these cuttings may enhance the microtopography of the area, providing attachment substrate or niche space which may increase the biological productivity of the area, although probably with different species. Because the mud fraction of the drilling discharge is expected to be highly dispersed and its toxicity has been reported to be very low, minor impacts to the canyon systems resulting from chronic discharges are expected.

The two cases of bulk discharge which are expected to cause the greatest impact are spudding in of the well and detachment of the riser. Both of these cases would release drilling muds and cuttings directly at the sea floor. These discharges would cause direct mortality to many individuals by burial. It is estimated that about 744 m2 of sediment surface could be covered by up to 1 m of drill muds and cuttings during initial well drilling. No estimate of areal coverage is available for the detachment of a riser. Depending on the specific location of the well, resorting forces may not be strong enough to redistribute these discharges. Therefore, the impacts may persist for a long time; however, they will be extremely localized. Increased sediment loads in the bottom water will be evident during these discharges. This may cause physical damage to or destruction of the filter apparati of some filter-feeding organisms, but it is not known how extensive this may be. Individuals which are destroyed should be replaced by the next recruitment period. However, mature communities that are disrupted may have to proceed through long-term initial successional stages before they reach pre-drilling conditions and may actually be changed completely if factors influencing the community development allow other species to competitively exclude the dominant species. Although trace metals are elevated in drilling muds, these muds have been reported as having low toxicities. Therefore, no impacts resulting from toxic reactions are expected.

If the discharge of bulk drilling materials at the sea floor occurs in the area of a "pueblo village," it is expected to cause local but short-term impacts. These villages are typically in areas of consolidated Pleistocene clay with an appreciable hydrodynamic energy regime. This should facilitate the resuspension and removal of the loose drilling mud discharges; however, the exact impact on these biologically productive areas is not known. The burrowing or burrow-living nature of the organisms found here indicates that no long-term impacts should persist, and the mobility of the organisms indicate that no direct mortality should occur.

Surface oil spills should have no major impact on canyon areas because of the appreciable water depths of the area. Petroleum hydrocarbons can reach the canyon areas by adsorption onto particulates that may settle out of the water column to the canyons, or by incorporation into zooplankton fecal pellets which then sink to the bottom. In both these cases, the impact on the canyon areas is expected to be negligible because of the dispersed nature of the particles. A subsurface oil spill within a canyon, however, could pose an appreciable threat to the biota in its vicinity. Currents in canyons have been shown to be tidally driven and therefore cyclic in their direction of flow. Therefore, dissolution of the lighter, toxic fraction of the oil may cause mortalities as the water which contains these fractions washes back and forth across the area. Coating by the oil may also cause mortalities in the vicinity of a blowout. In general, the effects of a blowout in a canyon area would vary with the factors which are site-specific.

CONCLUSION: Potential moderate impacts may result from the proposed action.

CUMULATIVE IMPACTS: At this time, very few cumulative impacts to canyon systems are evident. Because of the generally rugged topography and deep water, fishery activity is minimal and basically restricted to trap or long-line methods. No existing leases for U.S. oil and gas exploration and development are currently in effect in the north Atlantic area. Canada has gained control over a region of Georges Bank around the Northeast Peak and is expected to permit oil and gas activity in the future, but impacts to U.S. canyon areas are expected to be minimal. Canyons are thought to be concentrators of fine particulates which move off the shelf. There is also some indication that toxic Polynuclear Aromatic Hydrocarbons (PAHs), which are derived from onshore combustion processes and other anthropogenic sources, may be associated with these fine particulates (Payne, 1985). The impact that these PAHs may have on the filter-feeding canyon fauna has not been determined at this time, but it is assumed that it is low.

CONCLUSION: The proposed action would be the main cause of impact on north Atlantic canyon systems in the cumulative case. The overall impact level for the cumulative case is moderate.

### (i) Impact on marine sanctuaries

There are no marine sanctuaries, at present, in the north Atlantic area. There are, however, three sites on the Site Evaluation List (SEL) and it is reasonably foreseeable that these sites may attain sanctuary status. These sites are: Mid Coast Maine, Stellwagen Banks, and Nantucket Sound-Shoals/Oceanographer Canyon. The Mid Coast Maine site is not expected to sustain any impact from OCS activity resulting from the proposed action. There is a slight possibility of an offshore oil spill reaching this area. However the predominant currents in the area, combined with the lack of OCS oil transport in the vicinity, the location of the majority of the planning area, and the low probability of a spill occurring, dictate that there would be minimum risk involved. The risks to the other sites, because of their location in the planning area, is much greater. Both Stellwagen Banks and the Nantucket Shoals-Sound/Oceanographer Canyon sites could sustain severe local impacts as a result of the assumed 1 oil spill of 1000 bbl or greater, or the discharge of drilling material proximate to the sites. Because of their limited size, the relatively shallow water over the sites (except for Oceanographer Canyon), and the predominant currents which would transport an oil spill, an appreciable risk to these areas is anticipated.

CONCLUSION: The proposed action represents a moderate level risk to the potential marine sanctuaries in the north Atlantic.

CUMULATIVE IMPACTS: The existing potential impact to these areas is generally high. The shallow-water Nantucket Shoals/Sound area and Stellwagen Banks are most at risk because of the present tanker transport of petroleum and fishery activity. The later activity causes habitat destruction and/or modification as a result of dragging trawls or scallop dredges and a decrease in the biological component of the system. Generally, however, the physical effects are short-term and a return to existing conditions occurs in 1-2 years because this represent a re-sorting of naturally occurring materials. The estimated 2.05 oil spills attributed to the current transportation of petroleum however, represent a potential long-term impact.

The Mid Coast of Maine site is greatly removed from petroleum transport lanes and Oceanographer Canyon is in deep water and its rugged topography generally excludes many fishing activities. Therefore, the overall cumulative risks to these areas are much lower.

CONCLUSION: The overall estimated level of cumulative impacts would be high.

### (5) Socioeconomic Environment

#### (a) Impact on employment and demographic conditions

The search for and discovery of oil and gas resources within the North Atlantic Planning Area could create employment opportunities and consequently increase population levels. These changes have both positive and negative attributes thereby giving an indication of the socioeconomic well-being of communities, counties, States or regions.

The proposal could generate a regional total of approximately 1,900 jobs during peak activity. The estimate was derived through the combination of MMS's resource production schedule with several widely accepted OCS development studies [NERBC, 1976a, 1976b; Roy F. Weston, Inc., 1978; South Florida Regional Planning Council (SFRPC), 1983; Northeast Florida Regional Planning Council (NFRPC), 1983] as well as environmental impact statements for the North, Mid- and South Atlantic Planning Areas oil and gas lease Sales 82, 111, and 90. This total employment figure represents less than 0.1 percent of the region's civilian labor force.

A regional peak population increase of about 4,900 persons could be associated with the projected employment increase. This represents less than 0.1 percent of the region's population, implying little or no significant stress on the public and private service and facilities of the region as a whole.

The population increases generated, while minimal on a regional basis, may not be uniformly insignificant throughout the region. Impacts are potentially more significant in those counties or independent cities in which direct investments of offshore-related primary activities may be located.

CONCLUSION: The level of activity associated with this proposal will result in a very low level of impact on socioeconomic factors on a regional basis, and very low to low impact on a local basis. The only county likely to be appreciably affected is Washington County, Rhode Island where the support base facilities are expected to be located.

CUMULATIVE IMPACTS: The northeastern section of the United States is expected to continue a decline in population as more people migrate toward the southern and western parts of the United States. The typical blue collar industries will continue to provide fewer job opportunities as more light industry, high technology firms replace traditional manufacturers. Therefore, oil and gas development on the outer continental shelf will provide a stabilizing effect by providing employment opportunities to occupational groups that would otherwise nave reduced employability.

Population in the planning area is expected to decline by 7 percent by the year 2000 from the 1980 census figure of 22,198,295 (Dept. of Commerce, Bureau of the Census, 1983). This continues a trend that began in the 1970's and is characteristic of the out migration of people toward the southern and western portions of the United States.

CONCLUSION: Development in the planning area is expected to shift toward light industry, high technology. A declining employment, population base will be looking for employment opportunities as they become available. Impacts to the planning area are considered low.

### (b) Impact on coastal land uses

Exploration and development of the North Atlantic Planning Area may involve a variety of activities and facilities which can only be speculated upon at the pre-sale stage. In order to assess potential impacts upon coastal land use this EIS embodies the activities and facilities which are likely to result from OCS exploration and development in the form of development scenarios. The components of these scenarios are summarized in Section IV.A.. These assumptions of generally foreseeable developments are reasonable judgments of what may occur, not what will occur or even what is proposed to occur. When actual sites are being evaluated for new or expanded uses, all facilities will follow the necessary Federal, State, and local permit processes to ensure acceptable sites are chosen and adverse impacts mitigated as local and State laws require.

Major onshore components of the scenario for the North Atlantic Planning Area include a new gas pipeline and landfall, a new gas processing and treatment plant, and existing support base facilities. The support base is assumed to be located in Davisville, Rhode Island. No assumption has been made at this time with respect to the pipeline right-of-way and the location of the gas plant. A gas processing and treatment plant would require 50-75 acres of well-drained, level land, the bulk of which is for buffer area.

Previous lease sale EISs for the north Atlantic have reviewed the potential for land-use impacts of a pipeline and gas plant located north of Boston in the Cape Anne area, in the industrialized area of Lynn, Massachusetts, and in southeastern Massachusetts near New Bedford. This last alternative is coupled with a pipeline landfall at Little Compton, Rhode Island. This configuration was the only one considered in the last north Atlantic lease sale EIS (Sale No. 82). The EIS noted that such a pipeline would probably need to avoid all five of the Ocean Sanctuaries identified through the

Massachusetts Ocean Sanctuaries Act and would be subject to permit review by both Rhode Island and Massachusetts. In addition, such a proposal would be subject to a variety of Federal reviews including that of the Federal Energy Regulatory Commission (FERC).

All natural gas produced on the OCS is considered interstate and, thus, comes under the purview of FERC. An applicant to build a pipeline to transport OCS-produced natural gas must obtain a Certificate of Public Convenience and Necessity from FERC. In its application to FERC, the pipeline company must show how the construction and operation of its proposed facility will conform to State and local laws, permit requirements, and policies. According to FERC's guidelines, the construction and maintenance of facilities authorized by certificates granted under section (7)(c) of the Natural Gas Act should be undertaken in a manner that will minimize adverse effects on scenic, historic, wildlife, and recreational values. These guidelines also recognize the need to fit the construction of pipeline facilities into existing State and regional land development plans. FERC may hold public hearings on a proposed right-of-way prior to granting its approval.

The facilities for a support base currently exist in Davisville, Rhode Island consuming about 150 acres of land. This support base has serviced all exploratory activities in the North and Mid-Atlantic Planning Areas to date. Since they are existing facilities, no land-use conflicts are anticipated if it remains the support base for future OCS activities. Expansion of facilities, if necessary for a permanent support base, could be accomodated on approximately 450 acres available for OCS activities. The RICMP document, as amended (Olsen and Seavey, 1983), includes Quonset/Davisville in the State's "large inventory of unutilized and underutilized port facilities" available for redevelopment through the Rhode Island Port Authority. The Rhode Island Coastal Resources Management Council has stated that:

> OCS support bases could be accommodated at Quonset/Davisville within a framework of balanced and environmentally sound development. Therefore, a high priority use . . . at Davisville shall be commerce and industry related to and/or supportive of OCS oil and gas exploration. (RICMP, 1978)

It is assumed that existing facilities serving the Gulf of Mexico will fulfill the pipecoating requirements for the proposed action. Oil produced in the north Atlantic will be transported via gathering lines to single point mooring systems in shallow water and then by tanker to existing refineries in the Delaware Bay area. No oil pipelines to shore are anticipated. Expansion of neither the pipecoating facilities nor the refineries will be required. Helicopter services can be located in any existing commercial airport along the coast and would not require expansion of facilities. Because these requirements can be met by existing facilities without expansion, no conflicts with land-use plans or policies are anticipated.

CONCLUSION: The components of the OCS exploration and development in the North Atlantic Planning Area, in particular the gas pipeline and processing plant, are expected to have moderate impacts on land use in north Atlantic coastal areas. All activities and facilities are expected to be sited in generally compatible areas. Detailed siting approval and procedural requirements are expected to mitigate those impacts which may occur.

CUMULATIVE IMPACTS: Most individual development projects, whether OCS-related or of some other type, in and of themselves are likely only to produce minor land-use impacts, especially in relation to the region as a whole. However, when combined with other general development pressures, significant negative impacts on land use in the coastal zone may occur. Coastal areas have experienced extremely rapid growth in the past 20 to 30 years, exerting tremendous pressures on the coastal environment. The accommodation of this growth required the development of commercial and industrial centers, transportation terminals, residential complexes, and expanded tourist and recreational facilities. Often, uncontrolled and unplanned development has damaged coastal resources. Although overall growth is not expected to continue at the same rate as in the past 20 to 30 years, development activities if left unchecked have the potential for damaging coastal resources in the future.

State and local land-use plans and coastal zone management programs, however, are intended to promote balanced development. While development pressures are expected to remain, these plans and programs should control and guide development in such a way as to avoid widespread negative impacts.

CONCLUSION: Impacts on land use in the coastal zone could be high or very high in the cumulative case. However, adherence to coastal zone management programs, other policy programs, and local land-use plans should help reduce these impacts.

### (c) Impact on commercial fisheries

A complete generic discussion of the potential impacts to fish resources, which could affect commercial fisheries, can be found in Section IV.B.1.a.(4)(c). Generally, standard operations of the OCS oil and gas industry would have minor impacts on fishery activities in the north Atlantic area. The primary conflict would be competitive exclusion of commercial fishermen from relatively small areas because of oil and gas structures, and this would be mainly limited to the commercial trawl fishery. The major structure which could obstruct commercial fishing would be the 1 assumed pipeline that would be required to transport gas to the mainland. However, because no pipelines have been constructed in the north Atlantic, it has not been determined if only an adverse impact to the commercial fishery would occur. It has been demonstrated in the Gulf of Mexico that some species orient to the pipeline corridors-probably because of increased protection or increased prey--and that the fishermen preferentially trawl next to these areas to increase their catch. Presently, there are not substantive data to predict the response of north Atlantic species. The maximum negative impact that could be derived from the gas pipeline would be complete exclusion of trawl fisheries from the pipeline corridor and the 0.8 km (0.5 mi) buffer zone (0.4 km, 0.25 mi on either side). Recent production scenarios have estimated that approximately 640 km (400 mi) of gas pipeline would be required and would be placed in areas which would conflict with commercial fisheries. This would indicate that a maximum of approximately 512 km2 (200 mi2, 51,200 hectares) may be excluded from commercial fisheries. This is approximately 0.5 percent of the north Atlantic shelf area, excluding the 3-mile territorial waters.

The most severe impact to commercial fisheries could occur as a result of an oil spill. Only one oil spill (> 1,000 bbl) is assumed over the development and production period of the two sales in the program (35+ years). If a spill occurs around the spring season when many commercial species have spawned pelagic eggs, there is a potential for an impact that would result in decreased stocks in later years. However, the probability that a spill large enough to cause an impact would occur as a result of the proposed action is very small (1 percent chance of occurrence), assuming equal probability of occurrence at any time of the year. Impacts to commercial fisheries in the Georges Bank region as a result of oil spills were investigated by the MMS-funded study "Assessing the Impact of Oil Spills on a Commercial Fishery" (URI and ASA, Inc., 1982). It was determined that the stock recruit condition at time of impact and species-specific compensatory behavior are the most important considerations in determining the magnitude of impact on a particular fishery. Therefore, of the commercial fisheries in and near the planning area, those species demonstrating recruitment from a few year classes and with a limited ability to recover from large mortalities are more likely to experience reduced future catches if a spill occurs and contacts the resources. A simulation model based on cod (Gadus morhua) indicated that the greatest catch loss would occur in the fourth year after the spill and estimated a maximum annual loss of 6.4 percent. The cod fishery is treated here as representative of all major north Atlantic groundfish industries. To simulate this loss, the model had to be initialized using an enormous 68 million gallon (1.6 million bbl) well blowout over a 30 day period. This is unrealistically high in view of the resource estimates in the area. Unfortunately, biological data used in modeling impacts of oil spills on cod and herring were and still are not available for all Georges Bank commercial fisheries. Similar, but less specific, biological data are compiled in annual assessments of commercial fishery stocks in the Northeast United States (NFMS, 1983).

CONCLUSION: The impact as a result of the proposed action is expected to be very low.

CUMULATIVE IMPACTS: By far the most severe impacts on commercial fisheries are due to overfishing the resource. As with most groundfish stocks in the North Atlantic, the cod fishery resource is listed by NMFS as being fully exploited (NMFS, 1983). Cod landings, for example, have declined 27 percent between 1983 and 1984.

Emplacement of 11 platforms and one pipeline resulting from the proposed action, combined with increased support vessel traffic and fishing port conflicts in the form of competition for repair and docking space would further constitute adverse impacts on the commerical fisheries.

An additional major threat to the commerical fishery is the potential for the 2.05 spills greater than 1,000 bbl estimated to occur as a result of the present transport of petroleum hydrocarbons through the planning area. This represents a much more likely source of a spill large enough to cause a severe impact on fisheries than the proposed action because of the quantity of the more toxic refined fraction transported and the probability of a spill occurring.

CONCLUSION: The cumulative impact on commerical fisheries is estimated to be high, and the proposed action will not modify this level.

#### (d) Impact on recreation and tourism

Tourism and recreation constitute fundamental elements of the social and economic structure of the north Atlantic coastal region. The proposed action has some potential for affecting these resources, particularly with respect to land-use competition, visual effects, and oil spill impacts.

The landfall of a gas pipeline to be constructed for the production years at a site such as Little Compton, Rhode Island [see Section IV.B.1.a(5)(b)], may temporarily compete for land suitable for, or currently used for, recreational purposes. Recreational beaches have previously been used for landfalls of such pipelines. For example, in 1967, Transco constructed a natural gas pipeline connecting New Jersey and Long Island with the eastern landfall at Long Beach, New York. Long Beach is a sandy, heavily used recreational beach on the southern shore of Long Island, about 15 mi from Manhattan. Installation of the pipeline at Long Beach occurred during September, so that there would be no conflict with peak summer recreational use of the area. The beach restoration was completed by the end of November and the beach was available for recreational use the following summer. The landfall remains virtually unchanged and indistinguishable from its surroundings (NERBC, 1981).

Recreational beaches in other parts of the country have also been used as pipeline landfall sites. A pipeline landfall and beach crossing at Padre Island National Seashore in Texas removed 1,200 to 1,500 linear ft of shoreline from public beach use for approximately 2 to 3 weeks during the peak season. This construction phase disrupted access to heavily used areas and required detour routes. Two other pipeline landfalls, also constructed during peak season, did not present problems because of low usage levels in the affected areas. Burial of the pipeline in nearshore waters tended to attract sport fishermen. Most predictable adverse effects, such as disruption of public access or impacts on visual amenities, are temporary and associated with the construction phase. As long as construction is timed for an off-peak season for recreational use, and the site is restored to its previous condition, there should be little conflict between the landfall or right-of-way of the pipeline and the potential or actual recreational use of the land. Future pipeline landfalls may utilize directional drilling technology, further reducing the onshore impacts of pipeline construction.

A gas processing plant would be constructed near the landfall site, consuming 50 to 75 acres of land. Siting of such a facility would require extensive review and permitting procedures. It has been determined that there are ample industrial areas in the coastal north Atlantic to accommodate such a facility [see Section IV.B.1.a(5)(b)]. An example is southeastern Massachusetts, near New Bedford. Pipeline rights-of-way would need to be acquired between the landfall and the new facility. Short-term construction-related impacts can be anticipated from the pipeline installation.

Onshore facilities supporting offshore oil and gas activities can be accommodated without necessarily conflicting with coastal recreation. In addition, any onshore facilities would be sited in accordance with applicable Federal, State, local, and coastal zone land-use policies [see Sections IV.B.1.a(1)(c) and IV.B.1.a(5)(b)]. It is thus unlikely that any such facility would be sited in an area used or suitable for coastal recreation.

Visual impacts could possibly result from nearshore placement of OCS exploration and production facilities. The development scenario calls for 2 offshore platforms and the drilling of approximately 44 wells. A person standing on shore may be able to observe some portion of an exploratory rig up to 30 mi away (derived from Bowditch, 1975). From an observation point 400 ft above the shoreline (e.g., the top floor of a high-rise resort hotel/condominium), the theoretical extent of visibility to a rig would be approximately 50 mi.

The majority of the North Atlantic Planning Area is more than 50 miles offshore, eliminating any potential for onshore visual impacts resulting from offshore facilities. However, the planning area does extend shoreward to the States' 3-mi territorial limit. In the unlikely event of offshore facility placement in the blocks closest to shore, certain visual impacts would occur. These impacts diminish significantly with distance from shore. For example, if exploration takes place in blocks 25 mi offshore, an observer on shore would have about 280 ft of a rig 300 ft in overall height obscured below the horizon, even in the most ideal of conditions. Atmospheric and less than ideal weather conditions greatly reduce this range. Such a rig with a light on top would very likely only be visible at night, if at all, and even then would probably be indistinguishable from an ocean vessel. Thus, on the whole, the potential for onshore visual impacts from OCS exploration in the North Atlantic Planning Area is quite small.

The potential for spillage of oil from drilling and transporting activities offshore presents the greatest concern for the recreation and tourism industry of the coastal areas. Although only one oil spill of 1,000 bbl or greater is assumed to occur in the North Atlantic Planning Area as a result of this program, if such a spill reached a beach area, the local economy of the area would be adversely affected. The extent of impact from such a spill is extremely difficult to assess, since the degree of impact depends on many variables that cannot be known in advance. These include the size and duration of the spill, the composition of the oil, dispersion and weathering of the spill, cleanup efforts, and the amount of oil that actually comes ashore. The beaching location and the physical, social, and economic structure of the area of impact are also key factors because of both the type and magnitude of coastal resource use.

A key factor in the level of impact on coastal recreation resources is the time of year the accident occurs. Although the summer is generally the peak season for coastal recreation and tourism, a spring beaching occurrence could potentially have even more serious impacts than a summer spill. Springtime planning for the popular summer vacation could be heavily influenced by adverse publicity associated with a particular beaching occurrence causing shifts of recreation activities to alternative areas.

Many recreation/tourism operators are small, marginally profitable enterprises. The loss of most or all of a summer season's income could have not only the obvious impacts of loss of jobs and income, but also may undermine the viability of the enterprises for succeeding summer seasons. Moreover, people who vacation and/or periodically recreate in an alternative locale during that summer season may form preference patterns which would result in their avoidance of the affected locale in subsequent years even though the area was once again suitable for use. On the other hand, with a spill being localized, and given the tendency of people to select nearby, similarly situated areas as an alternative, the net loss of participation on a regional and even county basis might be only marginal. Such effects were observed after the 1969 Santa Barbara Channel oil spill (see below).

The peak summer tourist season would undoubtedly be disrupted in the event of a major oil spill, at least for the duration of spill beaching and cleanup operations. If a beach is relatively accessible, cleanup can be accomplished in a matter of days through the mechanical removal of oil-soaked sand. Efforts to replenish the sand, if necessary, could take an extended period of time.

A spill during the fall or winter season would not result in as significant an impact on coastal recreation and tourism because of seasonal reduction in demand. Additionally, an oil-beaching occurrence during this time of year would not have a significant impact on the following summer season's activity assuming timely and effective cleanup activities as well as sufficient positive publicity of these activities.

Numerous actual oil spills have occurred which present the opportunity to examine and evaluate the impacts of a spill in a given situation with variables identified. These case studies, while not predictive of future oil spills, do provide illustrations of the nature and extent of impacts on various resources. Summaries of various historical spill studies are provided below, especially as they relate to the recreation and tourism industry.

The world's largest accidental oil spill, the IXTOC I, contacted coastal areas of Texas. The economic effects of the spill were examined in an

MMS-funded study (Restrepo and Associates, 1982). This study found that total tourism and recreation losses were about $6.5 million, primarily in the communities of South Padre Island, Port Isabel, and Port Aransas. The losses were not distributed equally in the affected areas; rather, they were absorbed by a small number of businesses close to the water's edge in the recreation-oriented areas. There is evidence that the recreation business loss at the water's edge was offset with additional recreation-related spending elsewhere in the area. Interviews by persons associated with waterfront businesses in the affected area indicated that losses occurred only in 1979; these losses did not continue for 1980 and 1981.

Studies of the January-February 1969 Santa Barbara oil spill indicated similar impacts (Mead and Sorensen, 1970). Short-run trade diversion occurred as a result of the spill, depressing the motel and restaurant business near the ocean in favor of the neighboring Goleta area. Overall tourist activity in the county, however, was not significantly affected by the spill and, as a result, no social costs could be determined.

The wreck of the AMOCO CADIZ in March of 1978 affected about 400 km (about 250 mi) of the Brittany coast of France. Studies by the National Oceanic and Atmospheric Administration (USDOC, NOAA, 1983) indicated that economic losses to the tourist industry in the area totaled between $28 and $60 million. Non-marketvalued social costs associated with recreation in the area were estimated to be the equivalent of $13 to $82 million.

Other spills have had little or no effect on local travel industries. The ARGO MERCHANT which ran aground and sank approximately 29 mi southeast of Nantucket Island, Massachusetts, resulted in no measurable losses to the tourist industry. Tourist trade after the spill was as good or better than the previous season. (USDOC, NOAA, 1977).

During the first 6 months of the United States' involvement in World War II, the waters within 50 mi of the U.S. Atlantic coast experienced the destruction of numerous merchant vessels and cargo ships at the hands of German U-boats. This destruction included the spillage of roughly 3.5 million bbl of oil--the equivalent of 20 ARGO MERCHANTs, almost 1 per week for 6 months. Although the vast majority of this oil made its way out to sea and dissipated, significant amounts did contact the coastline. Although the exact impact of these WW II sinkings on the tourist and recreation industry have not been quantified, it can be stated with some certainty that, at least locally and in the short term, significant adverse economic impacts were experienced, especially on the Jersey shore. However, available documentation (Campbell et al., 1977) indicates that the overall effects of the oil spills were "negligible" and in both cases, the regional economy "survived with little difficulty."

Which, if any, of these historical spills approximate what could happen in the north Atlantic is virtually impossible to determine for reasons previously stated. Based on the order of magnitude of potential resources to be found, it is assumed that 1 spill will occur in the North Atlantic Planning Area as a result of the proposed action. Previous EISs have utilized the Oil Spill Risk Analysis Model (OSRAM) to assess the likelihood of spill contact with coastal areas. These simulations suggest that unless drilling activities were to occur in very nearshore areas, the probability of spill contact to coastal areas from such activities is quite small.

Oil produced in the North Atlantic Planning Area is assumed to be transported via gathering pipelines and tankers to refineries in Delaware Bay. Coastal recreation areas face a greater likelihood of contact from a transportation related spill, especially a nearshore tanker spill, than from a spill further offshore in the planning area--if one should occur. It should be noted however, that although the scenario for the proposed action includes these tanker routes, the risks associated with spills from these routes would still exist because of ongoing transportation of crude and refined products through the area, unrelated to Atlantic OCS activities.

The north Atlantic coastal region could experience some local dispersion of tourist trade and a reduction in recreational activity if a major oil spill were to occur and contact coastal recreation areas. This is unlikely to occur, however, as a result of the proposed action alone. In the event of an actual occurrence and contact, the most severe impacts on coastal recreation and tourism may be negated or substantially reduced because of seasonal fluctuations in demand. Other factors such as oil spill weathering, dispersion, and cleanup and control measures which are not included in the modeling effort further reduce the likelihood of oil spills contacting coastal tourist beaches.

Title III of the OCS Lands Act, as amended, established an Offshore Oil Spill Pollution Fund. Through this fund, persons who sustain an economic loss as a consequence of oil pollution arising from OCS activities can be compensated. The regulations which implement this appear at 33 CFR 135 and 136 and are administered by the U.S. Coast Guard. Part 136 of the regulations sets forth the claims procedures. Thus, if this lease sale were to result in an oil spill that reached shore, owners and users of areas important for coastal recreation and tourism would be entitled to apply for compensation through this Fund.

CONCLUSION: The proposed action's impacts upon coastal recreation and tourism are anticipated to be very low. Although certain local areas may experience low or possibly moderate impacts in the unlikely event of oil spill contact, overall impact on the region should remain very low.

CUMULATIVE IMPACTS: Oil spills and land-use conflicts are the two major concerns which have the potential for producing cumulative impacts on coastal recreation and tourism. Activities which affect these cumulative impacts include the proposed action, other OCS activities, existing transportation, general development pressures affecting land-use patterns, and the role of the tourist industry in the area's economy.

Land-use conflicts resulting from OCS activities are not expected to occur in the cumulative case since it is not likely that facilities other than those associated with the proposed action will be developed to accommodate Atlantic OCS activities. General development pressures independent of OCS activities could compete for land which is currently used for, or suitable for, recreational activities. However, this is not likely. In developing a coastal zone management program, States are required to identify coastally dependent uses and to establish a regulatory framework which will ensure that coastal land resources are used appropriately. In addition to CZM programs, other State programs and plans, as well as local land-use controls would be effective in controlling development.

In the cumulative case, the total number of spills from all sources greater than 1,000 barrels which are expected to occur in the North Atlantic Planning Area has been calculated to be 2.90 (or an assumed number of 3 spills). Virtually all of this risk is from continuing tanker transportation of crude oil and refined products through the region. Only about 5% of this risk is attributable to the proposed action (see Tables IV.A.4.a.1 and IV.A.4.a.2). Thus, in the cumulative case, the increased potential for spill occurrence results in greater likelihood of spill contact with coastal recreation resources. These risks which are substantial and are much greater than for the proposed action alone will exist primarily because of continuing levels of crude oil and refined products transported through the region. For the most part, such risks would exist regardless of past, present, or proposed OCS activities.

Although certain local areas may be adversely affected by an oil spill if one should occur, tourism and recreation is a well established industry in the coastal north Atlantic area and is expected to remain as such. There are no predictable factors, including OCS activities, which are anticipated to depress the tourist industry or displace its role in the region's economy.

CONCLUSION: In the cumulative case, the potential exists for moderate impacts to coastal recreation areas. These impacts, resulting from oil spills, would tend to be local in nature, not extending over the region as a whole.

### (e) Impact on archaeological resources

#### (i) Prehistoric archaeological resources

Prehistoric archaeological resources include aboriginal artifacts (such as stone bowls and tools) which may occur singly or in clusters, and habitation sites either, onshore or offshore. An Atlantic OCS Region in-house report prepared in November 1982 identified a total of 552 blocks within the North Atlantic Planning Area as having a medium-to-high probability of containing prehistoric archaeological artifacts. Forty-eight of those blocks are in the central portion of Georges Bank. The majority of the remainder lie in the vicinity of Martha's Vineyard and Nantucket Shoals. A few blocks lie just outside the 3-mi limit off eastern Massachusetts and Maine.

OCS oil and gas activity may have both negative and positive impacts on prehistoric archaeological resources. During the geophysical and geological evaluation phase of exploration activities both positive and negative impacts are possible. Seismic surveying and bottom sampling may result in identification of previously unknown sites thus providing a benefit to archaeological research. On the other hand, bottom sampling could also result in the disturbance of buried resources. Because archaeological interpretation is heavily dependent on the relative placement of artifacts within a site, such disturbances could be very damaging.

The majority of possible impacts during the exploration and development phases are negative in nature. Rig and platform installation could disturb both surface and buried resources. Drilling muds, cuttings, and fluids may damage sites by means of chemical activity but also could afford protection by burying the site.

Based on information obtained from pre-drilling surveys, lessees would be able to take actions which would avoid or lessen many potentially negative impacts on prehistoric archaeological resources. In some cases, however, indicators of archaeological sites (e.g., shell middens) are sometimes hard to detect and therefore, adverse effects by oil and gas activities may result.

If blocks within the zones of greatest archaeological potential are leased, prehistoric resources which may be present in those blocks could be affected by oil and gas activities. However, because there are no known prehistoric sites in this area, it is very difficult to quantify the expected level of impact.

Nevertheless, only a very small percentage of the North Atlantic Planning Area is within the zone of medium-to-high archaeological probability. Also, only a low level of activity is projected with only 2 platforms assumed in the mean case scenario. Consequently, the overall impact of the proposal on prehistoric resources occurring within the area is expected to be low. In addition only 1 gas pipeline is projected for the planning area. Should an archaeological site be located within the pipeline corridor, damage to or destruction of the resource could occur. However, in the north Atlantic there is usually a fair amount of sediment cover over landforms which might contain prehistoric sites, and this minimizes danger to the potential sites. Consequently, only a low level of impact on prehistoric resources located along pipeline rights-of-way is expected.

Prehistoric sites located in tidally influenced areas, on the other hand, could be severely affected by an oil spill. Oil could contaminate prehistoric artifacts and oil spill cleanup operations could disturb or destroy artifacts. The construction of processing and storage facilities at onshore locations could result in the damage or destruction of prehistoric archaeological resources. However, the probability of this occurring is remote as State and environmental regulatory agencies have opportunities to review plans for onshore development related to offshore oil and gas activity.

### (ii) Historic archaeological resources

Historic archaeological resources include shipwrecks or sunken aircraft offshore or historic buildings, sites, bridges, and districts onshore.

The potential for impacts on historic archaeological resources in the North Atlantic Planning Area is greatest in the shipping lanes south of Nantucket Shoals. This is an area of heavy shipwreck concentration. Smaller concentrations exist at the eastern end of the Great South Channel, eastern Georges Bank, and Nantucket Shoals.

Potential impacts on shipwrecks are both positive and negative in nature. As with archaeological artifacts, exploratory activities might result in identification of previously unknown wrecks. However, the magnetic signature of the dispersed remains of a shipwreck could easily be masked by a platform or pipeline near the shipwreck. Any objects placed on the ocean floor may crush a fragile wooden wreck. Finally, spilled oil could contaminate a shipwreck and oil spill cleanup operations could damage or destroy a wreck.

Many potentially negative impacts on historic archaeological resources could probably be avoided through the use of information obtained during pre-drilling surveys. Shipwrecks could be located through pre-drilling surveys required under OCS Operating Order No. 2, and, once identified, could be avoided by means of directional drilling and other techniques.

Because shipwreck data are rather limited, it is very difficult to quantify the expected level of impact. However, areas known or expected to contain heavy concentrations of shipwrecks are rather limited within the proposed lease area. Also, a low level of activity is projected for the proposed lease offering with only 2 platforms assumed in the mean case scenario. Consequently, the overall impact of the proposed lease offering on historic resources is expected to be low.

If a shipwreck is located in the path of the natural gas pipeline, damage to or destruction of the resource could occur. However, before a pipeline route is actually decided upon, a survey would be required. Such surveys, conducted with sidescan sonar, sub-bottom profiler, and possibly magnetometer, could locate many shipwrecks which might be present in the proposed corridor. The pipeline could then be realigned in order to avoid possible conflicts.

Because the majority of historic structures in the immediate tidal zone are protected by bulwarks or other barriers, damage from an oil spill would be largely esthetic in nature. Additionally, any historic sites eligible for or listed on the National Register of Historic Places are afforded protection under the National Historic Preservation Act of 1966, as amended. The siting of OCS-related facilities at onshore locations could adversely affect historic archaeological resources. However, because State and environmental regulatory agencies have opportunities to review plans for onshore development related to offshore oil and gas activity, the probability of this occurring is very remote.

CONCLUSION: Impacts on archaeological resources located within the proposed lease area, in onshore areas, and along pipeline rights-of-way are expected to be low.

CUMULATIVE IMPACTS: While in the cumulative case there are expected to be 11 platforms and 28 workboats, activities not associated with OCS oil and gas development would appear to present a higher probability of negative impact on archaeological resources, both prehistoric and historic, within the North Atlantic Planning Area. Such activities include the transport by tanker of crude and refined petroleum imports through the region, onshore facility construction, trawling, sport diving and commercial treasure hunting, and channel dredging. Because there is a greater probability of an oil spill resulting from the continued importation of oil at present levels, historic shipwrecks and/or prehistoric sites could be contacted by an oil spill. Subsequent cleanup operations could damage or destroy the wrecks and/or sites. Construction of non-OCS-related onshore facilities could result in the damage or destruction of both prehistoric and historic archaeological resources. However, the impacts could be mitigated through compliance with a variety of permitting requirements, the coastal zone management programs of the affected States, and the National Historic Preservation Act of 1966. Because trawling by fishermen would affect only the uppermost portion of sediments, the risk to potential prehistoric sites would be low. With respect to historic shipwrecks, it is likely that the zone of disturbance would have already been affected by natural forces. While sport and commercial diving would probably have little impact on potential prehistoric sites, the removal of historic data from shipwrecks could be very damaging. Because most channel dredging takes place near the entrance to inlets and ports, both prehistoric and historic resources could be severely affected by such activities. This is because areas near the shoreline generally have a higher probability of containing archaeological resources than do areas further offshore. However, a mitigating measure would be the Army Corps of Engineers (COE) requirement that remote sensing surveys be conducted prior to dredging operations in many areas.

CONCLUSION: Impacts on archaeological resources could range from moderate to high because of the aggregate of varied activities occurring within the planning area.

#### (f) Impact on marine vessel traffic and offshore infrastructure

The major impacts to marine vessel traffic and offshore infrastructure (e.g. oil rigs, production platforms, and pipelines) that can be expected to occur as a result of OCS oil and gas activities would stem from the construction and location of offshore structures on the OCS during exploration, development, and production phases and the subsequent associated supply and crew boat and tanker activity. Navigational or operational errors in the vicinity of these structures may result in collisions, with possible associated human injury, loss of life, spillage of oil, or release of debris. If exploratory rigs or production apparati are sited near or within any of the Traffic Separation Schemes (TSSs) and/or Precautionary Areas (PAs) as well as in other high vessel traffic areas, there would be an increased probability of vessels colliding with these structures as well as with other vessels. However, for the mean case scenario, only 2 platforms are expected to be constructed in the North Atlantic Planning Area and crew and supply boat activity will not be overly vigorous. In the peak years of activity it is projected that only 5 supply boats will be servicing the platforms. In addition, it is projected that only 3 supply boats servicing the mid-Atlantic platform will traverse the north Atlantic area enroute to the support base at Davisville, Rhode Island. Therefore, it is expected that all parties concerned with vessel traffic will be able to adjust to the slightly increased level of vessel traffic and to the siting of structures within the planning area.

CONCLUSION: The impact on marine vessel traffic and offshore infrastructure is expected to be very low.

CUMULATIVE IMPACTS: With 11 platforms and 28 workboats the vessel activity and structure placement associated with the cumulative case represents a small percentage of all activities that may impact marine vessel traffic and offshore infrastructure. Because the north Atlantic is an area of especially heavy vessel traffic, there is always the potential for vessel collisions even without OCS leasing. Commercial vessel traffic presents the major source of potential navigational hazards. Current collision and accident rates are low, but are expected to increase in frequency, regardless of oil and gas activities, because of expected increases in commercial shipping.

CONCLUSION: A moderate level of impact on safe navigation is expected because of heavy vessel traffic primarily unrelated to OCS oil and gas activities.

#### (g) Impact on military uses

Potential use conflicts exist between OCS oil and gas activities and military operations because substantial portions of the North Atlantic Planning Area are used for various military operations. The specific military operating areas and activities which take place within the planning area are described in Section IV.B.1.a(2)(b) (Figure III.A.1.a.6-1).

Drilling and production activities taking place in certain locations could interfere with submerged military navigational and other exercises. Other possible use conflicts between OCS oil and gas and military training activities exist. Most of these conflicts have traditionally been mitigated through coordination between the lessee and the appropriate military authority. In certain instances prelease stipulations have been attached to leases within military operating areas. However, the level of activity expected within the planning area is low with only two platforms expected.

CONCLUSION: The level of impact on military uses resulting from the proposal is expected to be very low.

CUMULATIVE IMPACTS: The proposal represents only a small percentage of the activities taking place within the North Atlantic Planning Area that may conflict with planned military operations and training. These activities include recreational uses, commercial fishing operations, and the normal marine vessel traffic. To date, however, no serious conflicts have arisen between oil and gas or other activities and the military and no conflicts are expected.

CONCLUSION: Cumulative impacts are expected to be low.

### b. Unavoidable adverse impacts

Normal offshore operations associated with exploration, development, and production of hydrocarbon resources result in unavoidable adverse effects of varying degrees on water quality, plankton, benthic organisms, shellfish, finfish, commercial fisheries, marine and coastal birds, some endangered or threatened species, marine mammals, as well as coastal habitats. Conflicts with regard to land use planning also occur.

The discharge of drilling muds and cuttings would cause localized, temporary increases in suspended solids and accompanying trace metals in the immediate vicinity of drilling rigs. Discharged formation waters would cause localized, minor elevations in inorganic salts, trace metals, and hydrocarbon levels around platforms, with correspondingly reduced oxygen levels.

Oil spills and chronic discharges of oil would temporarily increase hydrocarbon levels in the water column. Oil released to the environment would disperse, undergo weathering, and in shallow areas could become entrained into the bottom sediments. Sewage discharges from rigs and platforms would increase local levels of suspended solids (organic matter), BOD, nutrients, and chlorine. Finally, temporary turbidity of the water column would be increased by pipeline placement which would cause resuspension of sediments.

It is assumed that 1 spill of 1,000 bbl or greater would occur as a result of the proposal. The quality of the surface, near-surface, and, to a lesser extent, deeper waters would be lowered temporarily by spilled oil that is not recovered. If oil is entrained in bottom or shoreline sediments, water quality degradation could continue over weeks, months, or even years as the oil is slowly reintroduced into the system or biodegraded.

Minor, temporary decreases in benthic and planktonic populations would occur in localized areas around drilling rigs because of the disposal of drilling muds and cuttings. Toxic materials used in mud mixtures may adversely affect some marine organisms in localized areas when drilling fluids and cuttings are discharged and settle to the bottom. Also, bottom sediments and biota would be temporarily disrupted by pipelaying operations.

Commercially important species may be affected by mortality to fish eggs and larvae and smothering of shellfish. Commercial fishermen would be negatively affected by spatial exclusion from fishing grounds. Additionally, possible damage to gear and lost fishing time could occur. Spilled oil would cause localized mortalities of finfish and shellfish, particularly at early stages of their development.

Endangered or threatened species, including marine mammals, are not expected to suffer any major adverse impacts to their remaining populations. However, it is possible that some individual animals might be adversely affected from activities or accidents related to the proposed action. Marine and coastal birds could suffer minor losses. Sensitive coastal areas (i.e., wetlands, estuaries, and sandy beach/dune areas) could take several years to recover from oil spill impacts.

A gas pipeline landfall would cause a temporary and local disturbance of beach and wetland habitats during the construction phase. Unavoidable conflicts with land-use planning resulting from pipelaying and related disturbances would be localized and temporary in nature. The single projected gas pipeline would require onshore rights-of-way and would be buried. Approximately 75 acres of land would be needed for the construction of a gas processing plant.

### c. Relationship between local short-term uses of the environment and the maintenance of long-term productivity

Short term is defined as the projected economic life of the project, and long term is defined as the period that follows the economic life of the project. The principal short-term use of the area would be for the production of oil and gas which are non-renewable resources.

Short-term adverse effects to marine biological communities would result from normal operations and oil spills. Short-term losses could include reductions in biological productivity, changes in marine habitats, reductions in populations of plankton, benthos, fish, birds, mammals and turtles, and changes in food web components.

After the project, impacts resulting from OCS activity in the proposed sale area would not occur. To date, there has been no discernible decrease in marine productivity in OCS areas where oil and gas have been produced for many years. It has been recognized that continuous, low level pollution from toxic chemicals, including oil, may adversely affect long-term productivity, but the extent of these long-term effects cannot be quantitatively determined until reliable data become available.

Of the species in the region protected by the Endangered Species Act, marine species may suffer some short-term adverse effects. Coast oriented endangered species probably would not be affected significantly. Important breeding areas for endangered whales are currently believed to be located outside the sale area. If, in the future, breeding areas are located in the region, OCS activities may have an adverse short-term and long-term effect on breeding success. Migrating whales must pass through the proposed sale area. Sale-related activities could lead to changes in the migratory behavior of these whales. Non-endangered marine mammals would suffer only short-term effects from the proposed action.

The proposed sales will result in employment and population increases and possible short-term adverse impacts to the social infrastructure of affected communities. A strain on existing public and private services could be expected if new OCS-related facilities are located in areas of low population with little current industrial base. However, in the long term, a return to equilibrium can be expected as population gains and indirect industrial development are absorbed into the expanded communities.

Short-term adverse impacts could occur to the recreation resources and tourist industry of the area if an oil spill contacted a beach during or just prior to the season of peak use.

Short-term use of the OCS for mineral extraction would preclude fishing in the immediate vicinity of oil and gas operations. Although fishing takes place within the proposed lease area, only a small portion of the total fishing area would be removed.

In summary, short-term, localized impacts, both environmental and socioeconomic, would result from the proposed sales. No long-term productivity or environmental gains with regard to natural resources are expected as a result of the proposed sales. Benefits are expected to be principally those associated with increased domestic supplies of oil and gas and lessened dependence on foreign sources.

### d. Irreversible and irretrievable commitment of resources

Development and extraction of hydrocarbons could represent an irreversible and irretrievable commitment of nonrenewable oil and gas resources. The conditional mean resource estimates for the proposed sales are 49 million bbl of oil and 961 bcf of natural gas.

An irreversible or irretrievable commitment of biological resources and their habitats could occur in the area of a massive oil spill, or nearby areas that are subjected to chronic low levels of pollution. However, it is anticipated that an affected area would recover from a spill and that the natural flora and fauna would eventually reoccupy spill areas. Exceptions could be an irreversible or irretrievable loss of an endangered species that may result if populations of such a species are affected by an oil spill, either directly or through food contamination, or by any other disruption or disturbance such as habitat loss that may result from the proposed sales.

Human deaths and permanent disabilities from OCS offshore operations are an irretrievable loss of human resources. Energy expended and equipment used in exploring for and transporting oil and gas reserves could constitute an irreversible and irretrievable commitment of resources.

The proposal would require land for a right-of-way for 1 natural gas pipeline and associated processing facility. Additional land for facilities stimulated in part by the proposed action could also be required. A decision to proceed with the proposal would result in the production of certain OCS-related goods and services. To the extent that resources would be drawn away from other uses, production of goods and services in other areas or of other types would be foregone.

### e. Impacts of a High Case Scenario

Introduction

Economically recoverable resources under the high resource estimate scenario for the North Atlantic Planning Area are estimated at 260 mmbbl of oil and 5.06 tcf of gas (Table IV.A.1-3). This reflects more than a five-fold increase in resources over the base case. Exploration in this high resource scenario would begin in 1990 with the most intense exploratory activity occurring during 1992-1994. Exploration activities are projected to cease after 1996. The first year of development/production wells and platforms is anticipated to be 1993 followed by periods of most activity during 1996-1998 for development/production wells and 1995-1998 for platforms.

The high resource estimate scenario calls for 103 exploratory and delineation wells, 138 development/production wells, and 11 platforms. This is more than five times the number of facilities projected for the base case scenario. Oil produced under the high resource scenario would be loaded onto tankers from platforms or from single-point moorings connected by gathering lines to subsea complexes and transported to refineries in the Delaware Bay area. Gas produced under this scenario would be gathered by small diameter gathering pipe and fed into one trunkline for transport to an onshore gas processing and treatment plant in the north Atlantic area.

Gas facilities: One gas processing and treatment plant is projected to be associated with the development of North Atlantic OCS resources. It is anticipated that such a facility would be designed and built to accommodate the high resource estimate should such resources be discovered. As in the base case, no assumption has been made at this time as to the specific location of this facility.

Support bases: The high resource estimate scenario includes utilization of support base facilities at Davisville, Rhode Island, as described in the base case scenario fc the North Atlantic Planning Area.

Platform fabrication and pipecoating: All platform fabrication needed under the high resource scenario will most likely occur at existing fabrication facilities in the Gulf of Mexico Region. In addition, numerous suitable facilities for pipecoating are located in the Gulf of Mexico Region and could be utilized if needed.

#### (1) Physical Environment

##### (a) Impact on water quality

Types of water quality impacts resulting from high case resource development would be the same as those described for the base case proposed action. The magnitude of these impacts, however, would be greater as the number of wells and platforms would increase approximately five-fold (to 241 wells and 11 platforms) (Table II.A.1-3) of that assumed for the proposed action. Consequently, the total volume of routine discharges released over the exploration and production period for the 2 sales would increase proportionately (to 3.3 million bbl of drilling muds; 0.7 million bbl of drill cuttings; 208 million bbl of formation waters; 179 million gallons of sanitary waste; 537 billion gallons of domestic waste). However, the volume of these waste materials would still be small compared to the large volume of the receiving water. Impacts would be of a generally limited and local nature as discussed in Section IV.B.1.a(2)(a). The materials would be rapidly dispersed or diluted, and their discharge would take place within a geographically large area, spaced over a long period of time--10 years for drilling of wells and 30 years for resource production. Because of these factors, impacts on water quality from these routine discharges would be temporary and minor in nature.

The assumed number of large (> 1,000 bbl) accidental oil spills under high case resource development is one--this being the same as for the proposed action. Also, no new additional support facilities which may affect onshore water quality are anticipated.

CONCLUSION: A low, overall impact on water quality is anticipated from high case resource development.

### (b) Impact on air quality

Air quality impacts characteristic of potential OCS activities and the regulatory framework for pollutant emissions are reviewed in the section on air quality (IV.B.1.a(3)(b)). Major impact producing factors on air quality from OCS-related activity are the combustion of raw material, evaporative losses, internal combustion related to power generation, and refinery/processing techniques. Resource estimates in the high resource estimate scenarios for the north Atlantic are more than 5 times higher than the base case scenario, resulting in an increase in OCS activities associated with the exploration and development of these oil and gas resources. The increased OCS activities, including exploratory drilling vessels, and an onshore gas processing and treatment plant, may raise the overall level of pollutant emissions in the region. However, facilities used for exploration, development and production of OCS oil and gas are subject to DOI air quality regulations, and, when applicable, the state Implementation Plans for attaining compliance with National Ambient Air Quality Standards under the 1977 Clean Air Act Amendments (see Section IV.B.1.a(3)(b)). As a result, only a marginal increase in pollutant emission levels would be anticipated in the high resource estimate scenario compared to the base case.

CONCLUSION: Under the high resource estimate scenario, impacts on air quality for the north Atlantic may increase to moderate from the low level anticipated for the proposal.

## (2) Biological Environment

### (a) Impacts on plankton

The major change in expected activities between the proposed action and the high case is the estimated number of wells with their associated discharges. These increased activities are not expected to increase the impact level of plankton communities. There is no increase in the assumed number of oil spills of 1,000 bbl or greater.

CONCLUSION: A low level of impact is anticipated for the high-case estimates.

#### (b) Impact on benthos

##### (i) Intertidal

Changes under the high resource estimate scenario from the proposed action [Section IV.B.1.a(4)(a)] will not add to or increase the cause of impact, such as the number of pipelines or oil spills, on the intertidal benthos. Therefore, no change in impact levels on benthic organisms is expected.

##### (ii) Subtidal

Under the high resource scenario a five-fold increase in the number of wells to be drilled is projected. This will increase the quantity of drilling discharges to approximately five times the amount estimated under the proposed action. Displacement or burial of benthos due to the additional wellheads and drilling discharges would increase. Impacts on benthos due to displacement will be high locally but are not expected to effect regional populations unless a high number of wells are drilled in a sensitive, defined area (e.g. scallop beds). Drilling discharges are expected to increase in total amount, but not discharge rate therefore, dispersal of discharges would occur as under the proposed action. Effects are expected to be very local and occur over a 14- to 20- year development period. Multiple well drillings in canyon areas could cause moderate impacts. The assumed number of oil spills for analysis purposes of 1,000 bbl or greater remains at 1. Local impacts from the larger quantities of discharge could be high and not as short-term as the ones expected for the proposed action, but on a regional basis impacts will change very little. Therefore, there will be change from the proposed action impact levels on benthic and planktonic organisms on a regional basis.

CONCLUSION: A moderate level of impact could be expected to benthos.

#### (c) Impact on fish resources

Under the high-case estimates of potential development, the overall impacts to fish resources are expected to change very little. Although the number of wells expected to be drilled increases greatly (241 in the high case), their direct impacts to the environment would be localized and temporarily distributed over a 14- to 20-year developmental period. The discharge of formation waters and routine operational discharges at well sites cause extremely localized and generally short-term impacts. The increase in wells would not elevate overall impact levels in the high case. Spudding in the additional wells would bury approximately 147,000 sq.m. (14.7 hectares, 36.3 acres) of ocean bottom, but this is small in comparison to the planning area. Therefore no increase in impact level on fish resources as a result of drilling muds and cuttings discharges is expected.

The most severe impact on fish resources would result from the accidental release of petroleum hydrocarbons. In the high case, the assumed number of spills greater than 1,000 bbl would be 1; the same as the proposed action. Therefore, no change in potential impacts as a result of an accidental oil spill is expected under the high-case scenario.

CONCLUSION: The overall impact to North Atlantic ichthyofauna, using the high case estimates, is expected to be moderate.

### (d) Impact on marine mammals

#### (i) Pinnipeds

Increase of activities from the proposed action to the high resource scenario are not expected to adversely impact species of concern in the North Atlantic Planning Area; the harbor and gray seals. The potential impacts on the pinnipeds due to the increase in the number of wells and quantity of drilling discharges remain the same as those in the proposed action. Though the service vessel and tanker traffic will increase, it continues to be unlikely that they will transit waters near grounds important to the mammals.

#### (ii) Cetaceans

Under the high resource scenario, an increase in impacts to cetaceans in the north Atlantic may occur primarily because of the increased amount of low frequency sounds emanating from the additional number of geological surveys, exploratory rigs, and production platforms. The increase in number of wells will increase the potential disturbances to migrating and feeding cetaceans. This type of disturbance, however, is considered to be local, non-lethal, and occurring only within several hundred yards of the source. The possibility of contact between vessels and cetaceans will increase, but impact levels are expected to remain low. Because the assumption of an oil spill greater than a 1,000 bbl occurring remains at 1, the low risk of contacting oil also remains.

CONCLUSION: The impacts on marine mammals in the North Atlantic Planning Area will increase from very low under the proposed action to low under the high resource scenario.

### (e) Impact on coastal and marine birds

Under the high resource scenario, the greatest potential source of impact on coastal and marine birds will be from the increased amount of drilling discharge. Routine discharges could degrade marine habitats. The chronic discharges or formation waters which contain small amounts of crude oil may increase the possible impact on the more pelagic species of marine birds. However, considering that the size of the planning area and the assumed oil production life of the field remains as in the proposed action, the daily discharge rate should not greatly increase potential impacts to the pelagic avian species.

The number of assumed oil spill occurrences greater than 1,000 bbl remains at 1. Therefore, the potential contact with an oil spill by pelagic birds, shorebirds, and wading birds will not increase from the proposed action. As discussed in Section IV.B.1.a(4)(e) indirect effects from the 1 spill will also remain low.

CONCLUSION: Impacts on coastal and marine birds will increase from very low under the proposed action to low under the high resource scenario.

### (f) Impact on endangered and threatened species

#### (i) Endangered or threatened birds

Endangered or threatened avian species of concern in the North Atlantic Planning Area are the bald eagle and peregrine falcon. The greatest source of potential adverse impacts on these species would be due to contact, transferring and/or ingestion of oil [see Section IV.B.1.a(4)(f)(i)]. For the high resource scenario, the assumed number of oil spills greater than 1,000 bbl remains the same as for the proposal (1 spill). Therefore, the possibility of either species contacting oil remains low. The expected five-fold increase in the quantity of drilling discharges could indirectly effect these species. The chronic input of formation waters [see Section IV.B.1.a(4)(f)(i)] could degrade the water quality, taint, or kill food prey of the peregrine at the site of discharge. However, the quantity of discharge is still small in this scenario in relation to the receiving waters and size of the planning area.

CONCLUSION: Under the high resource scenario impacts on endangered or threatened species can be expected to increase from very low to low.

#### (ii) Endangered or threatened turtles

The number of assumed oil spills under the high resource scenario remains at 1. Therefore, the possibility of turtles contacting oil is still small. As discussed in Section IV.B.1.a(4)(f)(ii) platforms are sites of potential contamination and contact with service vessels. Even though the number of platforms increases to 11, an increase in potential toxin accumulation is not anticipated. An increased possibility of contact with vessels due to an increase in traffic could be expected.

CONCLUSION: Impacts on turtles can be expected to increase from very low in the proposed action to low under the high resource scenario.

#### (iii) Endangered and threatened whales

As discussed in Section IV.B.1.a(4)(f)(iii), the greatest potential source of impact is from an accidental oil spill. As in the proposal, 1 assumed spill of 1,000 bbl or greater may occur. Therefore, no increase in impacts compared to the proposal is anticipated under this scenario. The five-fold increase in the number of wells and the increase in vessel traffic could increase impacts on whales. Effects from drilling and discharges will be local and short-term. Impacts from these activities will be depend on where the drilling occurs and at what time of year.

CONCLUSION: If oil and gas activities are concentrated in the deeper waters of the planning area, the sperm and sei whales could experience low impacts. Humpback and fin whales could experience moderate impact while the right whale could experience high impact depending on the amount of production and development activity that would occur in the Great South Channel.

### (g) Impact on estuaries and wetlands

Under the high case scenario, no increases in the estimated impacts on estuaries and wetlands are expected when compared to the proposed action. The major causes of impacts on these habitats are oil spills and pipeline landfalls. No increases over the proposed action in the number of these impact-producing factors are anticipated for the high case scenario. See Section IV.B.1.a(4)(g) for a description of potential impacts on these habitats.

CONCLUSION: The expected impacts on estuaries and wetlands are expected to be very low.

### (h) Impacts on areas of special concern

Submarine canyons are the areas of primary concern in the North Atlantic Planning Area. The potential impacts resulting from OCS oil and gas activities are discussed in section IV.B.1.a(4)(h) and should be referred to for specific information. The most likely causes of impacts to the canyon systems would result from the mechanical placement of well heads and pipelines (gathering and trunk) and the initial discharges of drilling mud and cuttings. The estimated increase from 44 wells in the mean case to 241 wells in the high case would greatly increase the potential impacts to canyon systems.

CONCLUSION: A potential high impact level may result from the proposed action, using the high resource estimates.

### (i) Impact on marine sanctuaries

At present, there are no marine sanctuaries in the north Atlantic area but three potential marine sanctuaries are on the Site Evaluation List (SEL) [see Section IV.B.1.a(4)(i)]. The Mid-Coast Maine site is not expected to sustain any impacts from the high-case proposed action because of its location away from the planning area and the predominant currents in the area which would decrease the potential of oil spill impacts. The probability of impacts to Stellwagen Banks or Nantucket Sound-Shoals/Oceanographer Canyon would appreciably increase under the high-case proposed action compared to the mean case. However, the impact level would remain the same.

CONCLUSION: The high-case proposed action represents a potential risk of moderate level to potential marine sanctuaries in the north Atlantic.

### (3) Socioeconomic Environment

#### (a) Impact on employment and demographic conditions

It has been estimated that under the high resource estimate scenario, economically recoverable resources would be approximately 5 times as much as the proposal for the North Atlantic Planning area. Total employment increases are expected to increase roughly in proportion to increases in resources. However, some economies of scale can be reasonably assumed so as to cause the increase in employment to be somewhat less than the increase in resources. The number of jobs created under the high resource scenario (both direct and secondary) of 4,300 would still represent less than 0.1 percent of the current regional employment level.

A regional peak population increase of 11,200 persons could be associated with the projected employment increase. This represents less than 0.1 percent of the region's population, implying little or no significant stress on the public and private service and facilities of the region as a whole. Impacts are potentially more significant in those counties or independent cities in which direct investments of offshore-related primary activities may be located.

CONCLUSION: Employment increases related to the high resource estimate scenario would have a negligible impact on the size and character of the region's labor force. Impacts at the local level would be minor. Impacts on population are expected to be negligible at the regional level and minor at the local level.

#### (b) Impact on coastal land use

Onshore facilities associated OCS exploration and production in the North Atlantic Planning Area are anticipated to be the same for this high resource estimate scenario as for the proposal's scenario. These scenarios include one new gas pipeline and landfall, a new gas processing and treatment plant, and utilization of existing support base facilities at Davisville, Rhode Island. Insofar as possible, these facilities and their potential locations are examined in Section IV.B.1.a(5)(b). It is anticipated that new facilities would be designed and built to accommodate the high resource estimates should such resources be discovered. Impacts on coastal land use are anticipated to be virtually the same for the high resource estimate scenario as for the proposal. No additional onshore facilities are included in the north Atlantic's high resource estimate scenario that have not already been analyzed under the proposed action.

CONCLUSION: Facilities such as the gas pipeline and processing plant are anticipated to have moderate impacts on land use in north Atlantic coastal areas. These and all other facilities which may be proposed are expected to be sited in generally compatible areas. Detailed siting approval and procedural requirements are expected to mitigate those impacts which may occur.

### (c) Impact on commercial fisheries

A complete discussion of the potential impacts to fish resources, which could affect commercial fisheries, can be found in Sections IV.B.1.a(4)(c) and IV.B.a(5)(2)(c), respectively. Section IV.B.1.a(5)(d) should be referred to for a comprehensive discussion of impacts on commercial fisheries. The major difference in potential impacts between the mean-case and high-case proposed action would be the result of increased exclusion of commercial fisheries from the additional well sites. However even with the additional wells and the gas pipeline, and assuming total exclusion, that all the wells will be in place at one time, and that all the wells would be on the continental shelf in the planning area, only 1 percent of the area between the territorial limit and the shelf break would be affected. Because the assumed number of oil spills of 1,000 bbl or greater is 1 in both the mean and high case, no increase in impact is expected.

CONCLUSION: The impact as a result of the proposed action with high-case estimates is estimated to be very low.

### (d) Impact on recreational resources

The types of impacts on coastal recreation and tourism in the affected area of the north Atlantic resulting form visual effects, oil spills, and land use would be the same for the total development scenario as for the proposed action [Alternataive I, see IV.B.1.a.(5)(d)]. No additional onshore facilities are anticipated for the total development scenario that are not already analyzed under the proposed action. The resource estimates for the total development scenario indicate greater than a five-fold increase in the amount of oil which might be produced. Consequently, the relative risk of oil spill occurrence and contact with coastal recreational resources is proportionally increased. Nonetheless, the expected number of spills from all sources for the north Atlantic resulting from total development still does not exceed one (see Table IV.A.4.a.3). Oil spill impacts under this alternative should not exceed those associated with the one spill already assumed to occur as a result of the proposed action--mean case.

CONCLUSION: Impacts upon coastal recreation and tourism in the case of total development are anticipated to be very low. Although certain local areas may experience low or possibly moderate impacts in the unlikely event of oil spill contact, overall impact on the region should remain very low.

### (e) Impacts on archaeological resources

In the high case there is projected an increase from 2 to 11 platforms; gas pipelines would remain at 1. Little increase is expected in the potential for damage to archaeological resources since industry interest has concentrated on the outer shelf and slope in areas of low archaeological resources potential.

CONCLUSION: Impacts to archaeolgical resources will remain low.

### (f) Impact on marine vessel traffic and offshore infrastructure

In the high case, there will be an increase to 11 platforms from 2 and the number of workboats will increase from 5 to 28. While this would increase the potential for collisions, the total number of platforms and workboats is still very small compared to the number of other vessels using the area.

CONCLUSION: The impact on marine vessel traffic and offshore infrastructure is expected to be low.

### (g) Impact on military uses

Potential use conflicts exist between OCS oil and gas activities and military operations because substantial portions of the North Atlantic Planning Area are used for various military operations. The specific military operating areas and activities which take place within the planning area are described in Section IV.B.1.a(2)(b) (Figure III.A.1.a.6-1).

Drilling and production activities taking place in certain locations could interfere with submerged military navigational and other exercises. Other possible use conflicts between OCS oil and gas and military training activities exist. Most of these conflicts have traditionally been mitigated through coordination between the lessee and the appropriate military authority. In certain instances, prelease stipulations have been attached to leases within military operating areas. The level of activity expected within the planning area is low, with the greatest level of impact expected during the drilling of exploration and delineation wells because the drilling rigs will be changing location every 4 to 6 months. Coordination between the lessee and the military commander will be critical during these periods.

CONCLUSION: The level of impact on military uses that will occur from the proposed action will be low.

## f. Alternative II - Subarea Deferrals

This alternative evaluates the deferral from leasing in the 5-year program of 13 additional subareas (14 subareas are deferred under Alternative I - The Proposed Action. Two of these 13 subareas are wholly or partially contained in the North Atlantic planning area.

### (1) Gulf of Maine (North of 42° 30')

The Gulf of Maine lies east of Massachusetts, New Hampshire, and Maine, extending eastward from the nearshore region to the inner margin of Georges Bank.

The State territorial waters of Maine, New Hampshire and northern Massachusetts form the western boundary of this subarea deletion candidate. The exposed rocky shore supports a dense and diverse assemblage of invertebrates which are an important food source for a variety of seabirds. A jet-like current in the Georges Bank area forms a quasi-permanent boundary between the Gulf and the Bank. High concentrations of commercial macrobenthic organisms and groundfish are found on the fringes of the area. Fishes of the Gulf of Maine demonstrate limited movement into adjacent waters. Most stocks are fully or nearly fully exploited. The endangered humpback and right whales are known to migrate into (spring) and exit (fall) the Gulf of Maine and more northern waters. The endangered leatherback turtle has been observed feeding in the Gulf in June and in more northern waters throughout the summer. The coastline from northern Massachusetts, New Hampshire, and Maine provides extensive recreational opportunity and supports a healthy tourism industry.

Deferral of this subarea would eliminate any potential for onshore visual impacts to coastal Maine, New Hampshire, and northern Massachusetts resulting from offshore drilling facilities. The risk of impacts to coastal recreation areas from platform spills would also be substantially reduced. The extent of this deletion would also reduce the likelihood of land-use impacts from onshore facilities in Maine, New Hampshire, or Massachusetts. Such facilities would likely be located elsewhere in the region. Overall, water quality impacts would remain unchanged. However, the potential of high impact to limited coastline, and especially embayment areas, resulting from a large acute oil spill would be substantially reduced to a low level. The potential for rapid transport of large amounts of freshly-spilled oil to the coast or towards the Bay of Fundy by the Gulf of Maine circulation would be virtually eliminated. Deletion of this subarea would further decrease the expected low impact on coastal and marine birds. A defferal would reduce local impacts from rig placements and oil spills on benthos, fish, and whales.

### (2) Atlantic Coast Nearshore Block Deferral

This subarea consists of a 15 mile buffer zone along the coast of the North, Mid-, and South Atlantic planning areas. In the North Atlantic, the area consists of medium sand grading to fine. Water depth is generally less than 100 m. It is a moderate-energy area, shifting and affecting the sediment surface. Endangered or threatened and non-threatened avian species inhabit and breed in the area. The area supports sufficient benthic populations providing some of the feeding grounds for bottom feeding fish. Some commercial fisheries species occur in this area, but most occur further offshore. The right whale is thought to feed in the area southeast of Nantucket. Several species of endangered or threatened turtles (leatherback and loggerhead) use portions of the area to migrate further north.

Deferral of this subarea would eliminate any potential for onshore visual impacts to coastal Maine, New Hampshire, and northern Massachusetts resulting from offshore drilling facilities. The risk of impacts to coastal recreation areas from platform spills would also be substantially reduced.

The potential impacts to endangered or threatened birds, turtles, and cetaceans in the north Atlantic region would remain unchanged if this subarea were deleted. However, possible local impacts to endangered or threatened species would be reduced. If this deletion option were adopted, the probability of an impact to shallow water or coastal areas resulting from a North-Atlantic lease sale would be reduced, but no appreciable decrease in regional impact level would occur.

### g. Alternative III - Add a Sale in the Straits of Florida

A lease offering in the Straits of Florida will have no appreciable effect on impact levels in the North Atlantic Planning Area. This is because any oil or gas discovered in the Straits of Florida would not be transported to north Atlantic ports and there would be no increase in the number of oil spills expected from the proposal. (Table IV.A.4.a.1 and Table IV.A.4.a.4). Therefore the impact levels would not change for any of the following categories:

- Physical Environment
  - Water Quality
  - Air Quality

- Biological Environment
  - Intertidal Benthos
  - Subtidal Benthos
  - Fish Resources
  - Estuaries and Wetlands
  - Areas of Special Concern
  - Marine Sanctuaries
  - Marine Mammals

- Socioeconomic Environment
  - Coastal Land Uses and Water Services
  - Employment and Demographic Conditions
  - Commercial Fisheries
  - Archaeological Resources
  - Marine Vessel Traffic and Offshore Infrastructure
  - Military Uses
  - Recreational Resources

Except for is a slight increase in risk to endangered and threatened species and seabirds because an increase in oil and gas activities in the Straits of Florida could impact the population of right whales and avian species that migrate to the north Atlantic.

### h. Alternative IV - Biennial Leasing

A biennial leasing program in the North Atlantic Planning Area would result in one lease offering in 1988 and one in 1990 (Table IV.B.1.h-1). The timing of the lease offering in 1988 is the same as for the proposal, but the timing of the 1990 lease offering has been moved up by one year. This change in timing would cause an increase in the probability of occurrence or degree of impacts, but this will not affect the numbers of oil spills or platforms identified for the proposal. Therefore the impact levels would not change for the following categories (Table IV.A.1-1, Table IV.A.4.a.1, Table IV.A.1-5, and Table IV.A.4.a.5):

- Physical Environment
  - Water Quality
  - Air Quality

- Biological Environment
  - Intertidal Benthos
  - Subtidal Benthos
  - Fish Resources
  - Marine Mammals
  - Seabirds
  - Endangered and Threatened Species
  - Estuaries and Wetlands
  - Areas of Special Concern
  - Marine Sanctuaries

- Socioeconomic Environment
  - Military Operations
  - Archaeological Resources
  - Marine Vessel Traffic and Offshore Infrastructure
  - Employment and Demographic Conditions
  - Commercial Fisheries
  - Coastal Land Uses and Water Services
  - Recreational Resources

Table IV.B.1.h-1. Schedule of lease offerings for a. The Proposal, and b. Biennial Leasing in Planning Areas other than the Central and Western Gulf of Mexico. (An X indicates that a lease offering has not been numbered.)

Alternative I - The Proposal

| Planning Area | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| North Atlantic | | Sale 96 | | | Sale X |
| Mid-Atlantic | | | Sale X | | |
| South Atlantic | | | Sale 108 | | |

Alternative IV - Biennial leasing in Atlantic OCS Planning Areas

| Planning Area | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| North Atlantic |  | Sale 96 |  | Sale X |  |
| Mid-Atlantic |  | Sale X |  | Sale X |  |
| South Atlantic |  | Sale 108 |  | Sale X |  |

### i. Alternative V - Acceleration Provision

If the acceleration provision is applied to the North Atlantic Planning Area, the result will be one lease offering in 1988 and one in 1990 (Table IV.B.1.i-1). The offering in 1988 is the same as the proposal, and the offering in 1990 is moved up by one year, from 1991 to 1990. This alternative will not increase the number of expected oil spills or platforms in the north Atlantic. (Table IV.A.1-1, Table IV.A.4.a.1, Table IV.A.1-6, and Table IV.A.4.a.6). Therefore the impact levels will not change over those identified for the proposal in the following categories:

- Physical Environment
  - Water Quality
  - Air Quality

- Biological Environment
  - Intertidal Benthos
  - Subtidal Benthos
  - Fish Resources
  - Marine Mammals
  - Seabirds
  - Endangered And Threatened Species
  - Estuaries and Wetlands
  - Marine Sanctuaries
  - Areas of Special Concern

- Socioeconomic Environment
  - Commercial Fisheries
  - Coastal Land Uses and Water Services
  - Recreational Resources
  - Military Operations
  - Marine Vessel Traffic and Offshore Infrastructure
  - Archaeological Resources
  - Employment and Demographic Conditions

Table IV.B.1.i-1. Schedule of lease offerings for a. The Proposal, and b. Application of the Acceleration Provision to all Planning Areas other than the Central and Western Gulf of Mexico. (An X indicates that a lease offering has not been numbered.)

Alternative I - The Proposal

| Planning Area | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| North Atlantic | | Sale 96 | | | Sale X |
| Mid-Atlantic | | | Sale X | | |
| South Atlantic | | | Sale 108 | | |

Alternative V - Apply the Acceleration Provision to Atlantic OCS Planning Areas

| Planning Area | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| North Atlantic | | Sale 96 | | Sale X | |
| Mid-Atlantic | | Sale X | | | |
| South Atlantic | | Sale 108 | | | |

### j. Alternative VI - Deferral of Leasing in Six Planning Areas

Under this alternative, there could be no leasing in the North Atlantic Planning Area. Therefore, impacts on the human and natural environment caused by the oil and gas activities of the proposed 5-year leasing program would not occur. Particularly, impacts on water quality, benthic organisms, fish resources, marine mammals, coastal and marine birds, and on endangered or threatened species in the North Atlantic Planning Area would be avoided. In addition, the expected low levels of impacts on recreational resources, employment (including the positive aspects of employment opportunities in the planning area), and on archaeological resources would not occur; use conflicts between NASA and military operations and oil and gas activities would also be avoided.

This alternative would reduce future potential OCS domestic energy production by 49 million bbl of oil and 961 bcf of natural gas--the mean conditional resource estimates for Alternative I. The reduction of available energy resources could necessitate increased imports of oil and natural gas, require more stringent energy conservation by industry and individuals, and at the same time, dictate the development and utilization of alternative energy sources to replace the energy resources expected to be recovered if the 5-year leasing program were put into effect.

Alternative energy sources likely to be considered as a result of this alternative would include crude oil and natural gas from non-OCS areas (presumably imports from foreign countries as well as domestically produced oil and natural gas), coal, hydroelectric power, and nuclear power. The most likely combination of energy sources other than OCS-produced oil and natural gas would probably consist of increased imports of oil and natural gas, domestically produced strip-mined coal, and increased conservation of energy resulting from increased prices and capital substitution. See Appendix C for details.

### k. Alternative VII - No Action

Under the no-action alternative, impacts on the human and natural environment caused by the oil and gas activities of the proposed 5-year leasing program would not occur. Particularly, impacts on water quality, benthic organisms, fish resources, marine mammals, coastal and marine birds, on endangered or threatened species would be avoided. In addition, the expected low levels of impacts on recreational resources, employment (including the positive aspects of employment opportunities in the planning area), and archaeological resources would not occur; use conflicts between NASA and military operations and oil and gas activities would also be avoided.

The no-action alternative would reduce future potential OCS domestic energy production by 49 million bbl of oil and 961 bcf of natural gas--the mean conditional resource estimates for Alternative I. The reduction of available energy resources could necessitate increased imports of oil and natural gas, require more stringent energy conservation by industry and individuals, and at the same time, dictate the development and utilization of alternative energy sources to replace the energy resources expected to be recovered if the 5-year leasing program were put into effect. A discussion of alternative energy sources is presented in Appendix C.

Alternative energy sources likely to be considered as a result of this no-action alternative would include crude oil and natural gas from non-OCS areas (presumably imports from foreign countries as well as domestically produced oil and natural gas), coal, hydroelectric power, and nuclear power. The most likely combination of energy sources other than OCS-produced oil and natural gas would probably consist of increased imports of oil and natural gas, domestically produced strip-mined coal, and increased conservation of energy resulting from increased prices and capital substitution. Possible impacts or obstacles to implementation of alternative energy sources or actions are discussed in Appendix C and Section III.A.7. Impact factors associated with likely alternative energy sources (Table II.B.7) include such items as increased air pollutant emissions (e.g., SO2 and particulates), disruption of land, elimination of wildlife habitats, increased water pollution (surface and ground) and waste disposal.

# 2. Mid-Atlantic

## a. Alternative 1

### (1) Interrelationship of Proposal with other Projects and Proposals

#### (a) Coastal zone management

All affected States of the Mid-Atlantic Planning Area (except Virginia, as noted below) have Federally-approved coastal zone management (CZM) programs. State CZM programs may restrict the placement of pipelines, refineries, or other support facilities in areas of particular environmental concern and may set standards for their placement elsewhere. However, some provisions for their appropriate location is required by the CZM Act, as amended.

The New York Coastal Management Program (NYCMP, 1982) includes numerous policies which would affect OCS activities as well as a policy to "encourage the development of energy resources on the Outer Continental Shelf . . . and ensure the environmental safety of such activities." New Jersey's program (NJCMP, 1982) encourages OCS oil and gas development as long as all related onshore and offshore activities do not result in long-term adverse impacts and are conducted in accordance with the policies of the program. Onshore activities in New Jersey related to the development and production of offshore hydrocarbons must be carried out according to specific energy facility policies which are based on the need for and acceptability of all proposals for new or expanded coastal energy facilities.

The Pennsylvania Coastal Management Program (PCMP, 1980) is supportive of the development of OCS oil and gas resources "provided that the necessary environmental safeguards are enforced through regulations by the appropriate federal and state agencies to ensure that the integrity of the adjacent fish and wildlife habitat is not irreparably damaged due to drilling and other development activities." It is unlikely, however, that much onshore development will occur in Pennsylvania as a result of OCS oil and gas activities. Existing Delaware Valley industries could nonetheless be utilized for refining of OCS crude, and other related activities.

Delaware's Coastal Management Program (DCMP, 1979) policies would prohibit new petroleum refineries in the "coastal strip", but they may be permitted further inland. Pipelines which terminate in the coastal strip are also prohibited. Overall, however, the specific policies on OCS activities indicate general support of OCS development and recognize the potential need for the construction of OCS-related facilities. The State encourages development of existing port areas, such as Wilmington and Lewes, for OCS support-base activities.

Maryland's Coastal Management Program (MCMP, 1978) indicates support for OCS development and Maryland seeks involvement in the administration of OCS lands to ensure that the safest, cleanest technologies are used during the exploration and production phases of OCS oil and gas development. Facilities such as natural gas plants, pipelines, intermediate oil production terminals or refineries, oil and gas storage facilities, operation bases, and fabrication yards must receive certification from the Maryland Department of Natural Resources before construction may begin.

The Commonwealth of Virginia also supports OCS activities provided they are consistent with Virginia's environmental policies and goals. Virginia's Coastal Management Program which is currently under review by NOAA will identify OCS onshore facility siting as a concern for coastal zone management.

For a discussion of the coastal management programs of those States not mentioned here which may be affected by OCS development in the Mid-Atlantic Planning Area (i.e., Massachusetts, Rhode Island, Connecticut, and North Carolina), see Sections IV.B.1.a(1)(c) and IV.B.3.a(1)(c).

The Federal Coastal Zone Management Act, in addition to promoting State CZM programs, established the Coastal Energy Impact Program (CEIP). The CEIP includes the following: grants for planning for social, economic, and environmental consequences of expected energy development; financial assistance for new or improved public facilities and services; and grants to ameliorate damage to recreational or other environmental resources when the responsible party cannot be found or charged with damage. Under the CEIP, numerous facility siting studies have been conducted by the States to identify compatible sites for OCS facilities. These studies will aid in the process of assuring that OCS activities do not result in otherwise avoidable conflicts.

For past OCS lease sales in the Mid-Atlantic Planning Area, the Minerals Management Service has analyzed generally foreseeable development resulting from OCS exploration in relation to the States' coastal management programs. The reader is referred to the Environmental Impact Statements for Lease Sale Nos. 40, 49, 59, 76, and 111 for this detailed discussion. Section IV.B.2.a(5)(b), entitled "Impact on Coastal Land Use," in this EIS, provides an overview of the kinds of impacts which may result from the proposed action and its interrelationship with coastal management programs and other land-use plans.

On the whole, it has been determined that a variety of options exist to ensure that OCS development can be accommodated within the context of coastal management efforts. The terms and configuration of the 5-year lease program, as proposed, contain no provisions that would prevent the program from being conducted in a manner which is compatible with the coastal management programs of the middle Atlantic States.

#### (b) Ocean dumping

Ocean dumping activities in the Mid-Atlantic Planning Area are described in Section III.A.2.a(6)--Ocean Dumping. The dumpsite locations are shown in Figure III.A.2.a.6-1 and in Visual No. 1 of the Mid-Atlantic proposed Sale 111 FEIS. Active dumpsites include the 10 dredged-materials dumpsites along the coast. Within or close to the New York Bight Apex area, the active dumpsites also include those designated for acid waste, cellar dirt, and wood incineration (which has periodic use). The 12-Mile Sewage Sludge Dumpsite is being terminated in a phased manner and the dumpsite for wrecks is presently inoperative. Further offshore in the Middle Atlantic Bight are the newly designated Deepwater Municipal Sludge Site and the Deepwater Industrial Waste Site.

There is a potential interaction of oil and gas activities with ocean dumping in that oil and gas exploration or production operations may cause the following: (1) present a use conflict in the designated dumpsite areas; (2) disturb the dumpsite bottom (sea-floor) resulting in water quality contamination or contact with hazardous materials (e.g., undetonated explosives, chemical munitions, radioactive materials); or (3) cause water quality degradation as a result of synergistic interaction of operational discharges with ocean-dumped waste. However, in the Mid-Atlantic Planning Area, these potential interactions are expected to result in resolvable conflicts in usage of the area, low impacts to water quality, and highly improbable contact with hazardous materials.

The potential of any use conflict between oil and gas operations and the dredged-materials dumpsites is highly unlikely in that all but one of these dumpsites are within State territorial waters (extending 3 mi from shore); the Mud Dump Site is approximately 4.6 mi offshore New Jersey. Potential use conflict with the other active dumpsites (e.g., Acid Waste or Cellar Dirt Sites) situated within or proximate to the New York Bight Apex is also very low based on their location. Should such a use conflict arise (e.g., OCS gas pipeline routing being proximate to a dumping site), this could be resolved through coordination and planning.

Further offshore, a potential use conflict exists with reference to the Deepwater Municipal Sludge Site, the Deepwater Industrial Waste Site, and the proposed North Atlantic Incineration Site. In these cases, the potential use conflict would be resolved by coordination between the U.S. EPA, the regulatory agency responsible for these dumpsites, and the lessees. The mitigating procedures, if needed, may involve adjustment of schedule and/or relocation of ocean dumping activities in synchrony with oil and gas operations (Federal Register, Vol. 49, No. 88; Anderson, P., EPA Region II--Philadelphia, personal communication, 1984).

In the areas where ocean dumping occurs within the planning area, the disturbance of the bottom by oil and gas activities would be minor-limited to such activities as the actual drilling of the sea floor and possible placement of subsea complexes and gas pipelines. These activities result in some bottom disturbance which, in turn, may cause minor, local degradation of water quality by resuspension of sediments potentially contaminated by ocean dumping.

Within the planning area are six major sites formerly used for dumping undetonated explosives (e.g., bombs and depth charges), and four major sites for dumping low-level (by-product) radioactive materials encased in steel drums. Disturbances of these potentially hazardous materials by OCS oil and gas activities (placement of 1 gas pipeline, installation of 1 production platform and drilling of 20 exploration, delineation and production wells) resulting from the 1 sale in the Mid-Atlantic Planning Area is highly unlikely. Also, MMS has authority under OCS Operating Order No. 2 to require a lessee to perform pre-drilling hazards surveys. This would include surveys to detect explosives and radioactive materials where such surveys may be warranted. Such precautions would minimize the probability that undetonated explosives or radioactive materials, especially those concentrated within the former dumpsites, would endanger drilling activities, or that radioactive materials would be released in the marine environment.

Some level of synergistic interaction, resulting in potentially additional impacts on water quality, may be possible if the dumping of ocean wastes and drilling discharges were to occur simultaneously and in proximity. It is possible that if this were to occur, the materials could form other compounds, the nature of which would depend on the waste components. For example, clays present in the drilling muds could provide sites for the attachment of substances present in the dumped wastes, such as heavy metals, and carry them to the bottom as the clays settle out (U.S. EPA, 1980a). Mitigation of synergistic impacts, as with potential area use conflicts, would be implemented through U.S. EPA coordination of ocean-dumping activities with the release of the lessee's drilling discharges. Thus, minimization of potential synergistic impact would be accomplished through the separation by space and/or time of the ocean-dumped wastes from the drilling discharges.

Overall, impacts from oil and gas operations on ocean dumping are anticipated to be moderate.

### (2) Projects Considered in Cumulative Impact Assessment

#### (a) Oil and gas activities (state and federal)

There are currently 109 active leases (Federal leases only) in the Mid-Atlantic Planning Area. The cumulative impact assessment will consider these active leases as well as the proposed and alternative scenarios including the transportation of domestic and imported crude oil and refined products.

#### (b) Military operations

The National Aeronautics and Space Administration (NASA) and the U.S. Department of Defense (DOD) both use portions of the Mid-Atlantic Planning Area. The planning area includes warning and operating areas of the U.S. Atlantic Fleet offshore Norfolk, Virginia, and extends north through the Atlantic City Operating Area to the Narragansett Bay Operating Area (Figure III.A.2.a.6-1). These Operating Areas are established to provide for the training of surface, submarine, and air units of the U.S. Armed Forces, and for the testing of ordnance, aircraft, and ships under the cognizance of the U.S. Armed Forces and other Federal agencies. While Fleet Operating Areas have no legal status, they are normally established in areas with superjacent airspace designated as a warning area. A warning area includes airspace of defined dimensions outside of U.S. territorial waters in which a hazard to aircraft exists. The NASA Wallops Island Flight Test Center in Virginia is an installation from which NASA launches rockets. Offshore, the Wallops Island Flight Test Center is the primary user of part of the Virginia Capes Operating Area. The NASA Warning Area is the region that the Wollops Island Flight Test Center requires to be kept free of surface activity during rocket launches (Figure III.A.2.a.6-1).

The area surrounding Norfolk, Virginia is homeport for the majority of U.S. Atlantic Fleet air and surface units. These units use warning areas W-386, W-72A, W-105, and W-108 for the following operations, training, and readiness requirements before deploying overseas:

W-386: Multiple training areas; used up to 360 days per year. Includes surface and airborne drone targets for surface and air weapons delivery including strafing, rockets and bombs, and antisubmarine rocket and torpedo firing. Naval Air Test Center (NATC), Patuxent River, and NASA Flight Test Center, Wallops Island, launch a variety of missiles with wide footprints in this area.

W-72A: Aircraft live missile firing area; used about 90 days per year. Distance from shore and area size are determined by radar coverage, missile impact zone, and safety zone considerations.

W-105: Submarine operating area; includes submarine transit lanes.

W-108: NATC development and test site for naval aircraft and associated weapons systems.

Tests over W-108 and W-386 involve supersonic flights at high and low altitudes, air-to-air and air-to-surface missile firings, low level cruise missiles, anti-submarine warfare system evaluations, and electronic warfare system evaluations. NATC uses these two areas for 500 to 700 test flights per year. Supersonic flights represent a sonic boom hazard which could cause limited damage to surface vehicles or structures. The footprints of the missiles cover several hundred square miles which must be clear of all surface traffic or structures. Electronic emissions have the potential to disrupt commercial communications systems.

Overall responsibility for DOD's Offshore Military Activities Program is vested in the Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics). Under the policy specified in 32 CFR 252, DOD will endeavor to accommodate, to the maximum extent feasible, joint use of any areas determined by the U.S. Department of the Interior (DOI) to have mineral potential. In addition, conflicts which may arise because of the differing requirements for mineral exploration and development and defense-related activities will be discussed and mutually agreeable solutions reached as early as possible in the planning process according to the Memorandum of Agreement between DOI and DOD, dated July 20, 1983.

### (3) Physical Environment

### (a) Impact on water quality

#### (i) Offshore

Under normal offshore operations, the primary sources of water quality degradation in the Mid-Atlantic Planning Area would be discharges (from exploratory and/or production rigs) of drilling muds and cuttings, formation waters, domestic and sanitary waste, and deck drainage. Discharge of these routine effluents is regulated by the U.S. Environmental Protection Agency (EPA) through issuance of National Pollutant Discharge Elimination System (NPDES) permits. Additional routine pollutant sources would be the resuspended bottom sediments (primarily as a result of pipeline burial) and the operational oil discharges from tankers.

Accidental sources of offshore water quality degradation would include the small (usually < 50 bbl) chronic oil spills resulting from such operations as fuel transfer or storage. A large (> 1,000 bbl) oil spill or release may result from a well blowout, tanker or platform accident, or a pipeline break. Also, accidental gas release may result from a pipeline break or seam leakage.

These sources (normal and accidental) of offshore water quality degradation are introduced and discussed in general for the Atlantic Region in Section IV.B.1.a.(3)(a)(i) -- (Introduction to Impacts for the Atlantic Region).

The most serious impact to offshore water quality within the Mid-Atlantic Planning Area would likely result from a large (> 1,000 bbl), acute oil spill which may occur as a result of a tanker or platform accident, a well blowout, or a major pipeline break. For the proposed action, which includes 1 sale, it is assumed that only 1 oil spill of greater than 1,000 bbl would occur within the planning area (Table IV.A.4.a.1). A high level of water quality impact may be expected if such a large oil spill occurred close to shore or was transported there by winds and currents, such that the oil was then tied-up within a low energy regime having poor circulation as in an embayment. This may result in elevated levels of oil and weathered products to be retained and reintroduced within the shallow water column for extensive periods of time. However, most of the Mid-Atlantic Planning Area is of an open ocean type with good circulation such that the 1 large assumed oil spill would likely be quickly degraded and its effects would be temporary, thus resulting in a low overall water quality impact.

Local water currents and depths would greatly influence the fate of the estimated 327,900 bbl of drilling muds and 88,280 bbl of drill cuttings which would be discharged by the proposed action. Generally, however, because of the relatively small volume of the drilling discharges compared to the large volume of receiving water, the predominantly rapid settling and dispersion of the discharged materials to background levels, and because discharges would be spaced over a large area and long period of time (approximately 8 years), impacts on ambient water quality are expected to be low. Also, only those muds designated by the U.S. EPA to be environmentally acceptable, as determined by bioassay test results, can be discharged on the OCS. The anticipated low impact on water quality from drilling muds and cuttings by the proposed action is in agreement with the general conclusion of minimal environmental risk determined by the National Research Council Marine Board study (NRC-MB, 1983).

Discharged formation waters (20 million bbl), which would be released over an approximate 25-year period, would be diluted rapidly and ultimately lost in the large volume of receiving water. Depending on hydrographic conditions, background levels of trace metals would be reached within a few hundred meters. The hydrocarbon content of discharged formation waters would be within the U.S. EPA's prescribed effluent limits [the concentration of oil should not exceed an average 30-day concentration of 40 mg/l (40 CFR 435)].

Minimal impacts are expected from the discharge of domestic wastes, sanitary wastes, and low levels of oil from such sources as deck drainage. These discharges are regulated by the U.S. EPA through the NPDES permit requirements and are quickly diluted to ambient levels in the receiving waters.

An increase in levels of suspended sediments and turbidity as a result of gas pipeline burial or breakage would be a local and temporary phenomenon. Operational discharges of oil from ships would not substantially affect water quality in that only a limited increase in shipping by oil tanker is associated with the proposed action. Also, recent stricter regulations now address discharges from vessels e.g., discharges are permitted only 50 mi beyond land.

CONCLUSION: A low, overall impact on water quality is anticipated from the proposed action (see Appendix A for impact level definitions). Discharge of routine effluents such as drill muds and cuttings and formation waters and the action of gas pipeline burial or breakage would result in generally localized and relatively minor water quality perturbations. Although a large accidental oil spill could cause a severe alteration of ambient water quality, this is likely to be only temporary.

CUMULATIVE IMPACTS: The importation of foreign oil by tanker into or through the Mid-Atlantic Planning Area poses a substantial risk for the occurrence of large oil spills. Of the total 22 large (> 1,000 bbl) oil spills assumed to occur in the Mid-Atlantic Planning Area from all oil spill sources during a 30-year period, over 16 of these spills are expected to occur from tanker transport of imported oil (Table IV.A.4.a.2). The remaining oil spill risk is attributed to domestic tanker transport and to OCS oil and gas activities, including the proposed action (Table IV.A.4.a.2).

Under a cumulative case consideration, the total OCS oil and gas exploration and production activities within the planning area would result in a substantial increase in the volume of routine discharges (drilling muds and cuttings, formation waters, domestic and sanitary wastes, and deck drainage). Compared to the proposed action alone, this increase may be as much as 14-fold for some of these discharges. However, the total volume of these materials would still be small compared to the large volume of the receiving water. These materials would be rapidly dispersed/diluted within a geographically large area and spaced over a long (possibly 30-year) period such that the impacts on water quality, from these discharges, would be low and temporary in nature.

Operational oil discharges from tank ships constitute a large oil input into east coast waters (estimated at 4.3 million gallons for the Atlantic area 3 to 400 mi off the U.S. east coast) (NOAA, 1984--preliminary results). However, the greatest concentration of dispersed and weathered oil from operational discharges expected to be found off the east coast (3 to 200 mi offshore) is only slightly greater than 0.1 gallons per sq mi (NOAA, 1984--preliminary results). Thus, the overall impact on water quality from these discharges seems low.

A major activity affecting water quality within the planning area has been associated with the disposal of industrial waste and some municipal sludge at the 106-Mile Ocean Waste Disposal Site located 106 nmi southeast of Ambrose Light [ocean dumping is also discussed in Section III.B.2.a(6) and Section IV.B.2.a.(1)(d)]. The U.S. EPA has now designated two smaller sites for industrial waste and municipal sludge within, and as a replacement for, the 106-Mile Site. Water quality impacts from these two new sites are anticipated to be short-term and limited (Federal Register, May 4, 1984). Also, an extensive area southeast of the 106-Mile Site has been proposed by the U.S. EPA for at-sea incineration of organic wastes, primarily organohalogens (U.S. EPA, 1981a). The U.S. EPA has estimated that the waste constituents from this proposed action would be dispersed and diluted in air and water to undetectable concentrations within a few hours of emission.

The New York Bight receives considerable pollutant loadings from ocean-dumped wastes and from municipal and industrial discharges through ocean outfalls, from surface and groundwater runoff to the Hudson River-Raritan Bay estuaries, and from atmospheric fallout. Water quality impacts include high BODs, excessive bacterial densities, oil and grease, and high concentrations of heavy metals, PCBs, and other potentially toxic concentrations of suspended matter.

CONCLUSION: A high long-term impact on water quality is anticipated when the cumulative effects of all actions are considered. The cumulative impact on water quality is considerably greater than that anticipated from the proposed action alone. Oil import by tanker represents a substantial oil spill risk which may cause a major impact on water quality. Also, water quality of the inner New York Bight area continues to be adversely affected by ocean dumping and contaminated outflows.

### (ii) Onshore

Onshore water quality degradation will occur as a result of increased non-point and point sources of pollution associated with the construction and operation of onshore facilities supporting the Mid-Atlantic Planning Area OCS activities.

Runoff from construction and operation of onshore support facilities constitutes a non-point pollution source. The construction of 1 new gas pipeline (and associated landfall) and 1 new gas processing plant will likely cause increases in surface runoff to nearby streams and rivers. This runoff would likely contain increased levels of suspended solids and heavy metals. Non-point source impacts may be minimized by controlling erosional effects generated within construction site boundaries, with several of the adverse impacts being localized and prevented from having offsite impacts to water bodies in the vicinity of these activities. Increases beyond normal background levels would be temporary and of a limited duration.

Increased effluent discharges will occur through point sources related to OCS-support activities, primarily the 1 new gas processing facility. Wastewater discharge from a plant would include chemicals such as chromate, zinc, chlorine, phosphate, sulfide, and sludge conditioners, as well as oil and grease (NERBC, 1976). Point source discharges, however, will be subject to Federal and State water pollution control regulations and permitting; thus, potential adverse impacts can be mitigated.

No other new support facilities (refinery, pipe-coating yard, platform fabrication yard, marine terminal, marine repair and maintenance yard, and support bases) are anticipated for this proposed action.

CONCLUSION: The overall impacts on onshore water quality are anticipated to be low.

CUMULATIVE IMPACTS: Sources which may cause degradation of onshore water quality in the Mid-Atlantic Planning Area, in addition to those associated with the proposed action, are diverse and numerous. These sources can be broadly categorized as intentional point (or pipeline) discharges, non-point discharges, and accidental discharges. The following discussion of these sources which may cumulatively affect onshore and nearshore water quality has been taken from NOAA's National Marine Pollution Program Plan (NOAA, 1981).

The major intentional point source discharges of waste materials into inshore and coastal areas come from sewage treatment facilities, industrial facilities, and electric-generating facilities. These pipeline discharges are regulated by the U.S. EPA through the National Pollutant Discharge Elimination System (NPDES). In 1979, more than 5,000 NPDES permits were held for ocean outfalls in coastal counties. The effluent from the industrial and sewage treatment facilities may contain, even after treatment, substantial quantities of synthetic organics, heavy metals, suspended solids, oxygen-consuming materials, and nutrients; sewage effluents may also contain fecal coliforms and potentially pathogenic microorganisms. Power plant cooling water discharges may be elevated in temperature and have increased chlorine levels.

Non-point source pollution occurs when runoff enters a body of water carrying with it pollutants from the land, such as petroleum hydrocarbons and lead from parking lots, pesticides and nutrients from residential lawns or agricultural fields, pathogens from faulty septic systems, or toxic materials from industrial areas (e.g., copper from a dry-dock hull-sanding area). In many areas the pollution from non-point sources is increased by the presence of coastal facilities and, in most regions, non-point source pollution accounts for a major portion of the contaminants that enter coastal waters. In contrast to the significant progress made during the 1970s in controlling industrial treatment facilities, progress with non-point sources is negligible (CEQ, 1980).

Accidental discharge of oil and hazardous materials into water bodies may occur during loading and unloading operations in ports and harbors, pipeline leakage, equipment failures, and spills from land vehicles and storage facilities onshore. The operation of some coastal facilities can result in large accidental spills or chronic unintentional discharges into coastal waters. For example, it has been estimated by Richardson et al. (1985) that, on the average, each fueling of a pleasure craft at a marina results in the spillage of a fluid ounce of gasoline or diesel fuel (NOAA, 1981).

In general, the onshore and nearshore water degradation in the Mid-Atlantic Planning Area is associated with areas of heavy urban and industrial development as in the harbor and adjacent areas of New York City. The proposed action represents one of many onshore impact-producing agents in the Mid-Atlantic Planning Area and as such represents a very small portion of the cumulative impacts on water quality.

CONCLUSION: The cumulative impacts on water quality, including effects from actions not related to the proposed action, are anticipated to be moderate overall; localized high impacts may occur in the heavily urbanized and industrialized coastal areas.

### (b) Impact on air quality

The types and allowable emission levels for air pollutants expected from OCS activities in the mid-Atlantic would be the same as those described for the north Atlantic [see Section IV.B.1.a(3)(b)]. The air quality impacts from an onshore gas processing and treatment plant would depend upon the characteristics of the particular gas stream being processed. Such impacts would be regulated by a variety of Federal, State and local requirements. OCS activities should not exceed the National Ambient Air Quality Standards because of DOI emission requirements. Potential problems could occur if OCS operations occur in proximity to the Brigantine National Wildlife Refuge (a Class I area). If the OCS activities were projected to have a significant effect on any Class I area, mitigation or termination of the polluting activities would be required under the regulations.

The development scenario for this action assumes that natural gas would be transported via pipeline to an onshore gas processing and treatment facility in a presently undetermined location. Such a facility would be individually designed for the particular gas stream that it processes. The type and magnitude of air emissions are determined by the volume of gas processed, the composition of the gas stream, plant design, and choice of pollution control equipment. If the gas stream contains a high concentration of hydrogen sulfide, $H_2S$ (i.e. "sour gas"), the "sweetening" process will result in large amounts of $SO_2$ emissions. $SO_2$ emissions resulting from the processing of "sweet gas" (low $H_2S$ content) are normally not a problem. Other potential pollutants from gas plants include nitrogen oxides, particulates, carbon monoxide and other hydrocarbon gases. A typical gas plant's emissions may include

| | (tons/year) |
|---|---|
| $NO_x$ | 1,590 |
| $SO_x$ | 221 |
| CO | 56 |
| particulates | 6 |
| hydrocarbons | 24 |

CONCLUSION: Proposed OCS activities in the Mid-Atlantic Planning Area should have only a very low impact on onshore air quality in the region.

CUMULATIVE IMPACTS: Resource estimates in the cumulative case for the Mid-Atlantic Planning Area reflect more than a fourteen-fold increase over the base case. Commensurate increases can be expected in OCS activities and resultant pollutant emissions. However, OCS facilities and activities would still be required to adhere to the DOI air quality regulations, and when applicable, the State Implementation Plans (SIPs) promulgated under the Clean Air Act Amendments of 1977. Non-OCS-related activities such as increasing industrial activities, automobile emissions, and urbanization may also contribute to air pollution problems over the next 20 to 30 years. A variety of measures such as the SIPs mentioned above and automobile inspection and maintenance programs should aid in controlling these emission sources. Recent trends on a national basis have indicated a fairly steady decline in major pollutants such as $SO_2$, CO, $NO_2$, and particulates. This decline has not been conclusively demonstrated for ozone which may remain as a pervasive pollution problem for the forseeable future. Available data indicate that the affected states of the Mid-Atlantic Planning Area reflect trends essentially the same as those found on a national scale.

In summary, although an increase in air pollutant loads might occur in the cumulative case, various measures currently in place on the state and national level, combined with other controls such as DOI's air quality regulations for OCS activities should be effective in limiting or even reducing the overall adverse impacts on air quality in the region.

CONCLUSION: Cumulative activities should not exceed a moderate level of impact on onshore air quality.

### (4) Biological Environment

#### (a) Impact on plankton

The potential impacts on plankton resulting from the release of muds and cuttings into the environment include the following: (1) increased turbidity causing decreased primary production because of reduced light levels; (2) increased particulate levels causing interference with or damage to filter-feeding apparatus; (3) burial of benthic communities; and (4) acute or chronic toxic effects from the constituents of the drilling muds.

Plankton in the mid-Atlantic as discussed in the north Atlantic can be found across the waters of any depth discussed. Particular species are more populous in the areas that provide the required nutrients. In conjunction with the phytoplankton are their predators zooplankton. Both demonstrate cyclic populations and zonal distribution across the mid-Atlantic. The mid-Atlantic is a vast body of receiving water in relation to the quantities of hydrocarbons, and drilling muds and cuttings estimated under the proposed action. The magnitude of the potential impacts are directly related to the concentrations of hydrocarbons, muds, and cuttings. Impact reducing determinants would be the magnitude and direction of currents within the water column and water depth. As discussed in the north Atlantic, plankton contact time with discharges is limited and in some instances plankton were seen to thrive in the presence of hydrocarbons. Where plankton populations have been decreased through OCS activities, the impacts are short-term because of the spatial and temporal variability of plankton.

There will be minor and extremely localized impacts because of decreased light transmittance, anoxia, and increased salinity from discharges of formation waters from rigs and platforms. The impacts will be primarily on the plankton community in the immediate vicinity of the discharge pipe, unless the formation waters are shunted close to the bottom.

CONCLUSION: Low impacts on plankton are expected as a result of the proposed action.

CUMULATIVE IMPACTS: Under the cumulative case the proposed action and existing leases will generate approximately 4,891,100 bbl of drill muds and 1,317,840 bbl of cuttings. In addition, the number of oil spills increases to 22. The majority of these spills will be due primarily to the transportation of imported foreign oil. Though the total volume of these discharges increases noticeably from the proposed action, impacts on plankton could be expected to be short-term. The discharge and spills are assumed to occur over approximately 25 years. Considering the size of the receiving waters and the number of activity years, plankton will experience high but very local impacts with short re-population times.

CONCLUSION: Impacts to plankton are expected to be low under the cumulative case.

### (b) Impact on benthos

#### (i) Intertidal

Under the proposed action for the Mid-Atlantic Planning Area, most OCS operational activities will occur beyond the States' 3-mile jurisdiction. When actual sites are being evaluated for new or expanded uses, all facilities need to follow the necessary Federal, State, and local permit processes to insure that acceptable sites have been chosen and adverse impacts are mitigated as local and State laws require.

Intertidal benthos would primarily be subjected to mechanical perturbations (pipeline laying), physical hazards (smothering), and physiological effects if an oil spill occurs and strikes land. The degree and duration of impacts will vary depending on the coastal topography, energy regime of the area, and quantity and quality of oil reaching shore.

The mid-Atlantic intertidal areas are medium to coarse sandy beaches or fairly high-energy barrier island beaches. Wave, wind, and tide effects are strong erosional and depositional forces. Algae growth is limited because of the lack of proper substrate in the high-energy area of shifting sediments. The environment is generally considered depauperate in benthic fauna.

The placing of a gas pipeline would disturb a limited area [see Section IV.B.1.a(4)(b)]. The trenching would cause an immediate local impact, but it would be short-term and have little effect in the shifting environment.

In the event that oil were to reach the intertidal zone in sufficient quantity and in an unweathered condition, the result would be a severe local impact. The oil could be driven into the sediment creating a potentially chronic, long-term toxic environment. Impacts, however, would generally be short-term because the high-energy environment of the intertidal zone typically would resuspend and eventually remove the oil from the sediment.

CONCLUSION: Impacts on intertidal benthos are expected to be very low.

CUMULATIVE IMPACTS: Existing leases are 50 miles or more offshore therefore drilling discharges are not expected to impact inshore areas. Under the cumulative case discharges will reach 4,891,100 bbl of drill muds and 1,317,940 bbl of cuttings. The number of assumed spills greater than 1,000 bbl could reach 22, the majority of which would result from tankers transporting imported foreign oil through the area. Considering the size of the planning area OCS activity will occur at a distance offshore limiting the chances of discharges or spilled oil reaching shore. The events and amounts discussed are projected to occur over an activity period of 25 years. In the event oil should contact the intertidal zone, the local fauna could experience a severe but short-term impact. Cleanup operations could hasten the removal of oil but could also cause further reduction in the local benthic population. Because oil in this high-energy environment will be resuspended and removed quickly, and population shifts are cyclic, impacts would be expected to be short-term.

CONCLUSION: Cumulative impacts on the intertidal benthos are expected to be low.

### (ii) Subtidal

Under the proposed action for the Mid-Atlantic Planning Area the occurrence of 1 oil spill of 1,000 bbl or greater will be assumed for analysis purposes. Estimates of 808,900 bbl of drilling mud, 218,880 bbl of drilling cuttings, and 54.4 bbl of formation waters are anticipated from drilling activities.

Benthos in the shelf region, measured in individuals per square meter, is dominated by annelids. The shelf is comprised of a ridge-and-swale topography and typically the swales have a higher density of benthos. The inner and mid-shelf support lower densities of benthos than the outer shelf and shelf break. Densities then decrease in a seaward direction in the deeper water.

Disturbances to shelf benthos by mechanical perturbation, well placement, and direct burial [see Section IV.B.1.a.(4)(b)] would result in a high local impact with a return to previous populations and communities immediately next to the well in 1 to 2 years. As discussed in Section IV.B.1.a(4)(b) amounts and resident time of deposited drill cuttings will vary with the environmental forces (e.g., currents, tides, hurricanes).

Generally, dilutions of drilling fluids reach low toxicities immediately after release (NRC-MB, 1983). Because of the great water depth over most of the planning area, dispersion of surface-released drill muds and cuttings will be appreciable. Localized impacts from drilling muds and cuttings will be evident during the initial drlling when drilling fluids and solids are ejected at the sediment surface. Approximately 8,000 ft2 (744 m2) per well are expected to be covered by up to 1 m of drilling discharges. Impacts which result from drilling fluid discharges are extremely localized and include: smothering of organisms around the borehole, and some distance down current depending on the hydrodynamics of the area; localized change of sediment granulometry; increase in body burdens of barium in local benthic invertebrates; interruption of filter-feeding patterns because of elevated levels of suspended particulates; and increased sedimentation rate around the well from routine or bulk discharges. The latter is highly variable depending on discharges, water depth, and current regime. Although the discharge of muds and cuttings may have a severe impact in the immediate area of discharge, no detectable effect on any regional population levels is expected. In the Mid-Atlantic Planning Area, the current velocities generally range from 5 to 40 cm/sec, therefore dilution of drilling discharges to low concentrations will occur very quickly.

If formation waters are shunted near the bottom, an area of benthos of approximately 300 m2 may be affected. In ecologically sensitive areas operators may be required to shunt all drilling discharges directly to the ocean floor preventing their lateral dispersion through the water column. Generally, formation waters are shunted near the water's surface.

The direct impact to the benthos from an oil spill will be greater in shallow water (<60 m), however, the extent of the impact is dependent upon variables such as the total amount of area contacted, time of year, physical regime of the area, composition of the crude oil product, and the biological system involved. The associated impact on the benthos could range from none to major depending upon the relative degree or status of those variables. In deeper waters (>60 m) benthos are most likely to have an indirect contact with oil rather than direct. Zooplankton fecal pellets are considered a form of transport of hydrocarbons from the surface to the bottom. Distribution is directly affected by physical regimes.

In the last 10 years there has been an increase in the number of studies on the effects of oil on macroinvertebrates. This is especially true for intertidal species. The National Academy of Science's report (1985) concludes that it is difficult to generalize about benthic and intertidal invertebrates since there is a great deal of variation among the genera and species and among the various life-cycle stages of any one species.

Mid-Atlantic canyon fauna contains attached epifaunal species. An adverse impact resulting from destruction of these species is expected to be mitigated within 1 year as these species use the structures as substrate.

The impacts on infaunal species would remain at the same level, or increase slightly if the structures cause changes in near-bottom currents that modify the habitat or niche space in the immediate vicinity of the structures. In either case the overall impact to infaunal species is expected to be minor in canyon areas. The greatest impact resulting from mechanical damage would occur in the "pueblo village" areas of canyons heads. These areas are extensive burrow systems that support a number of species such as tilefish, lobster, red crab, and cancer crabs. They would be highly susceptible to mechanical damage resulting from structure placement. It is not known at this time if placement of these structures would cause long-term local impacts, or if these structures may act as artificial reefs, mitigating adverse impacts after a short period of time. The placement of oil and gas structures in canyon areas may increase the turbidity, affecting filter-feeding organisms down-current from the site.

Because the turbidity is from natural sediment, and is short-term and localized, minor impacts to the canyon areas are expected. However, individual organisms may be damaged or destroyed. Impacts on canyon areas from formation water discharges are considered to be nonexistent. These discharges are in the surface waters far above the canyon area and are diluted to ambient levels within a short distance of the discharge pipe.

Surface oil spills should have no major impact on canyon areas because of the considerable water depths of the area. Petroleum hydrocarbons can reach the canyon areas by adsorption onto particulates that may settle out of the water column to the canyons, or by incorporation into zooplankton fecal pellets which then sink to the bottom. In both these cases, the impact on the canyon areas is expected to be negligible because of the dispersed nature of the particles. A subsurface oil spill within a canyon, however, could pose an appreciable threat to the biota in its vicinity. Currents in canyons have been shown to be tidally driven and therefore cyclic in their direction of flow. Therefore, dissolution of the lighter, toxic fraction of the oil may cause mortalities as the water which contains these fractions washes back and forth across the area. Coating by the oil may also cause mortalities in the vicinity of a blowout. In general, the effects of a blowout in a canyon area are not known and would vary with the

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factors which are site-specific.

CONCLUSION: Low impacts on subtidal benthos are expected as a result of the proposed action.

CUMULATIVE IMPACTS: Under the cumulative case there will be an additional 270 wells drilled. The total volume of drilling discharges will increase from the volumes under the proposed action. Oil spills could reach a high of 22, the majority of which would be from the tankers transporting imported foreign oil.

The non-OCS activity of dredge spoil disposal in the nearshore environment has a negligible impact in the cumulative case. Trawling in shallow water could redistribute sediments, however, it is expected that the impacts which result would be negligible and not distinguishable from natural re-sorting forces in the region.

Oil reaching benthos in shallow waters is expected to be resuspended and dispersed within a short period of time, eventually degrading. Deeper benthos are not expected to be contacted by oil other than the small quantities that may adsorb onto particles or be contained in zooplankton fecal pellets, both of which may settle to the bottom. The impacts caused by drilling muds and cuttings estimated to be discharged would be highly variable, depending on location, current velocity, and water depth which will determine the degree of accumulation of drilling discharges. Because of the low toxicity and quick dilution of drill muds and cuttings, sediment re-sorting forces in the region, and the number of years activity could occur during cumulation, impacts on the benthos could be expected to be moderate.

CONCLUSION: The cumulative impacts on subtidal benthos are expected to be moderate.

### (c) Impact on fish resources

Under the proposed action, 2 lease sales are expected to be held. The impacts on fish resources in the region would result from mechanical damage or modification, impacts from drilling discharges, or impacts from a potential oil spill [see IV.B.1.a.(4)(c)]. The mid-Atlantic area is typified by transitory habitation by various fish species. Therefore the range of impacts would vary widely, depending on the season in which they occur. The placement of structures to drill the wells or the proposed pipeline is of minor concern with respect to the overall impacts to fisheries in the planning area. These structures will exclude fishermen from certain areas, but the size of the exclusion area in relation to the planning area or the areal extent of the fisheries is relatively small. The mobility of the transitory commercial and recreational fish species found in the mid-Atlantic region would also lessen the effect of these low-level impacts. Generally, the placement of structures would not cause direct mortality to the fishery resources but would modify their distribution. The more benthically oriented species may be either repelled from the structures because of loss of prey or aggregation of predators, or attracted to the structures because of the protective habitat or increased forage area. The more pelagic species would generally sustain less impact as a result of structure placement. Some of the species, such as dolphin (Coryphaena hippurus), cobia (Rachycentron canadum), and some tunas are known to be attracted to structures and would orient to surface structures such as anchor-marker buoys and mooring buoys. The most severe impacts to fishery resources would occur to the basically non-mobile species such as ocean quahog, sea scallop, and surf clams. Because of the inner-to-mid-shelf location of these species, the primary impact generally would result from the laying of a gas pipeline to shore. However the relatively small area disturbed (19,000 m2 per kilometer of pipeline) in comparison to overall extent of the fisheries precludes appreciable impacts from occurring.

Drill muds and cuttings discharges, as a result of the proposed action, are estimated to be 808,900 bbl (128,615 m3) of mud and 218,880 bbl (34,802 m3) of cuttings. The general conclusions about drilling muds and cuttings in-include the following: they typically become widely dispersed with the surface plume becoming undetectable within 1 km of the discharge pipe; they are low in toxicity unless they contain appreciable amounts of hydrocarbons (usually diesel fuel), which are prohibited from being discharged in the Atlantic OCS; they demonstrate low bioavailability to higher trophic levels; and their impacts are generally limited to the area surrounding the well where accumulations of these discharges may persist in low energy areas, modifying the morphology and granulometry of the sediment surface (NAS, 1983). Overall, it is expected that the impact from drilling muds and cuttings may be high in proximity to a single well if it is in a low-energy environment. However it is not expected that any impact would be evident at the level of species populations. In addition, because the 50 wells will be drilled spatially and temporally separated from each other, no cumulative area-wide impacts from drilling discharges will be manifested.

Based upon the resource estimates of the 2 proposed lease sales and the assumed spill rates, the probability of an oil spill of 10,000 bbl or more resulting from the proposed action is very low (11 percent chance of occurrence), but the possible risk still exists. The most severe impact to fish resources resulting from an accidental oil spill would occur during the late winter, spring, and early summer when the majority of commercially and recreationally important species are spawning pelagic eggs. The relative severity of the impact would be linearly dependent on the areal extent of the spill and the specific location (deep water, outer shelf, inner shelf). If a spill occurs over the mid-shelf or outer-shelf areas during the spawning period, the potential for large mortality of the eggs and larvae of a number of fish species would be present. If a spill occurs over the inner shelf or nearshore, there would be the potential for direct oiling of benthic shellfish species of commercial importance, such as the surf clam and ocean quahog, which are primarily found in waters shallower than 60 m. The planktonic larvae of these species would also be at risk if the spill occurs and coincides with the spawning period.

The proposed action includes the possibility of transport to Delaware Bay of oil produced in the Mid-Atlantic Planning Area. The possibility, although of small probability, of an oil spill occurring within the confines of Delaware Bay poses a threat to commercially and recreationally valuable fishery species as well as lower trophic level species which are valuable as forage species. The potential for impact to various anadromous fish species, such as the alosids and striped bass (Morone saxatilus), or to juveniles of species that use the estuary as a nursery area, such as menhaden (Brevoortia tyrannus) or the scaienids, increases greatly if a spill coincides with the initial spring pulse of fish immigrating into the estuary. An appreciable impact to resident commercial or recreational species, such as blue crabs, hard clams, or oysters, from a nearshore or within-the-bay tanker spill could occur year-round. However the impact would be more severe if it occurred during spring--the spawning season of these species.

CONCLUSION: Based on the transitory nature and spatial extent of the majority of fish resources in the mid-Atlantic area, impacts are not expected to persist beyond 2 years and would therefore be designated as low.

CUMULATIVE IMPACTS: The major existing impact to fish resources which is present in the area is the result of the fishery industries. Virtually all of the commercial fishery stocks have been overfished and are much lower than historic levels. Most of the species have, or will have, a Fisheries Management Plan (FMP) in place to maintain a specific level of renewable resource and to attempt restoration of the stocks. The present transportation of petroleum hydrocarbons into and through the mid-Atlantic area poses the greatest threat of acute impact to fish resources. It is assumed that the oil production from the 2 lease sales in the North Atlantic Planning Area (estimated resource of 49 million bbl) and the single sale in the South Atlantic Planning Area (estimated resource of 69 million bbl) would be transported by tanker through the mid-Atlantic area into Delaware Bay. Although the 186 million bbl (including the mid-Atlantic estimates) of crude oil estimated to be transported through the region as a result of the proposed action pose an appreciable threat to the area, it is assumed that oil imports to the area would be decreased to maintain the present level of refining which is based on capacity and demand. Therefore the potential risk, as a result of petroleum transport, to Delaware Bay and its indigenous fish resources would not increase in the cumulative case. The production of oil in the mid-Atlantic area (estimated at 68 million bbl) would increase the risk to fishery stocks from an oil spill; however, the import of crude oil into the area of approximately 560 million bbl (1979 estimates) presents a much higher risk of potential impact.

CONCLUSION: The proposed action would slightly increase the risk of adverse impacts to the fish resources of the area, but the estimated level of impact would remain the same; very high.

### (d) Impact on marine mammals

The types of possible OCS-related impacts and the number and kinds of marine mammals affected by OCS activities in the mid-Atlantic would be very similar to those described for the north Atlantic [see Section IV.B.1.a(4)(d)]. However, the mid-Atlantic has few of the north Atlantic cold water species (e.g., gray seals or harbor porpoise). OCS activities in the mid-Atlantic could disrupt typical marine mammal activities, displace animals from preferred areas, and directly affect animals as a result of an oil spill. However, the level of impact on marine mammals should be very low because of the low projected number of wells drilled, production platforms, and required support vessel traffic. The 1 assumed oil spill should not significantly affect current population levels or permanently degrade preferred areas. Because of the size of the planning area and the low level of OCS activities, it is very unlikely that the one proposed sales could have a concentrated impact on nonendangered marine mammals in the mid-Atlantic.

CONCLUSION: Proposed OCS activities in the Mid-Atlantic Planning Area should have only a very low impact on nonendangered marine mammals in the area.

CUMULATIVE IMPACTS: Under the cumulative case some domestic, foreign and all oil produced under the Atlantic proposed action will be transported to the mid-Atlantic. The number of assumed oil spills increases noticeably (+21) and the majority (17) are due to the transportation of imported foreign oil. Assumed oil spills in the other planning areas could reach the mid-Atlantic area or be contacted by mammals migrating from the north or south, indirectly affecting marine mammal populations in the mid-Atlantic. Studies though show that dolphins tend to avoid oil and if they do contact oil the epidermis appears unaffected. Baleen whales could experience some accumulation of oil in the baleen, but this has been shown to be quickly removed when unoiled water is filtered through.

The increase in traffic will present a greater possibility of mammals and vessels contacting causing possible lethal injuries. Fishing practices where mammals may be injured or killed in other planning areas could also have an impact on mid-Atlantic populations.

Though the receiving area and waters are large the high number of wells and oil spills in the mid-Atlantic is compounded by the migratory nature of the species as they are susceptible to further impacts in other areas. Fishing practices where mammals may be injured or killed in other planning areas could also have an impact on the mid-Atlantic population.

CONCLUSION: Cumulative actions could have moderate impacts on mid-Atlantic marine mammals.

### (e) Impact on coastal and marine birds

The generic types of impacts that OCS operations and oil spills can have on seabirds are discussed in detail in Section IV.B.1.a(4)(e). The discussed impacts could occur to seabirds inhabiting the mid-Atlantic if the proposed action is adopted. However, the Mid-Atlantic Planning Area is known to be somewhat less important to most seabirds than is the north Atlantic. The mid-Atlantic is used primarily during winter migration while the north Atlantic is an important breeding area. In addition, the projected level of OCS activities (e.g., numbers of wells and platforms; production discharges) in the mid-Atlantic is very low. No additional processing facilities or onshore support bases would be needed under the proposed schedule. The 1 assumed oil spill could significantly affect seabirds if they should come in contact with it. This is an unlikely occurrence though because of the short time these birds spend in the area, the low number of birds in the area, and because of the low oil spill risk from producing the estimated oil resource.

CONCLUSION: OCS activities in the Mid-Atlantic Planning Area arising from the proposed 5-year schedule should have a very low level of impact on sea-birds.

CUMULATIVE IMPACTS: The presence of oil in any of the planning areas could impact seabirds in the mid-Atlantic because many species breed in the north Atlantic while the south Atlantic is important as wintering grounds for migrating species. Low mortalities of some marine birds could result in declines of populations in the mid-Atlantic. Potential impacts from possible oil spills increase in the cumulative case. A high number of spills are expected in the area as a result of transporting all Atlantic produced oil, domestic and imported foreign oil to and through the mid-Atlantic. The latter is estimated to contribute up to 77 percent of the potential spills. Valuable marine and coastal habitats from Cape Hatteras to Georges Bank could be degraded from exposure to a nearshore spill.

Impacts that are not related to oil and gas activities, but could contribute to a cumulative impact on avian resources include the loss of habitat due to private and recreational development. This would pose a threat to wading birds and shorebirds in particular. Industrial and sewage sludge wastes from designated ocean dumpsites could have an adverse effect on marine birds by degrading the ocean environment. Those species which migrate as far as Central and South America could be exposed to toxic substances (e.g., DDT), that will inhibit reproduction. However, transcontinental migratory species are protected and managed in accordance with international treaties. These treaties do provide a measure of protection to international migrants by requiring signatory nations to promote the conservation of these species.

CONCLUSION: The cumulative impacts are expected to have a moderate impact on seabirds.

### (f) Impact on Endangered and Threatened Species

The species of endangered or threatened birds, sea turtles, and marine mammals inhabiting the mid-Atlantic contain some of the same species as those in the north Atlantic area. Therefore, the same types of OCS-related impacts identified in Section IV.B.1.a(4)(f) could also occur in the mid-Atlantic. The Mid-Atlantic Planning Area is important to bald eagles which are typically found on or nearshore peregrin falcons. OCS activities associated with the proposed schedule should not affect these endangered birds because no additional onshore support facilities would be constructed and no conflicts with breeding or migratory stopover areas are anticipated. The probability of contacting spilled oil or eating tainted food would be low due to the low number (1) of assumed spills.

The mid-Atlantic is an important summer feeding ground for some endangered or threatened sea turtles, especially the loggerhead. OCS activities such as drilling could disrupt or displace feeding turtles. Or it is thought that turtles are attracted to platforms to feed on the fouling communities which develop on the structure. Species located on or near platforms could ingest hydrocarbons and trace metals discharged at the platform sites. The assumed oil spill of 1000 bbl or greater could directly affect individual turtles if it reached a feeding area by inhibiting or preventing feeding activity. However, only a low level of OCS drilling activity is expected to result from the proposed schedule. Therefore, it would be unlikely that any turtles would be seriously inhibited from feeding or permanently excluded from prime feeding grounds. The risk of contacting the 1 assumed spill would be low because of the size of the planning area and the seasonal absence of turtles from the area during the winter months. No significant nesting beaches are located in the mid-Atlantic limiting the possibility of oiling nests or hatchlings.

The right and humpback whales occur in the mid-Atlantic primarily during their spring and fall migrations. Fin and sperm whales can be encountered year-round with greatest numbers occurring during the spring and summer months. The blue and sei whales prefer more northern waters beyond the planning area. The low level of OCS drilling activity and support vessel traffic should not seriously interfere with breeding, feeding, or migrating activities as the whales in the mid-Atlantic are accustomed to heavy human use of the area. The 1 assumed oil spill is not likely to have a direct impact on any healthy individuals that can move away from contaminated areas. Sick animals and juveniles could experience more serious effects. The size of the planning area and the seasonal movements of each species would further reduce the odds of contacting an OCS oil spill. No preferred areas or critical habitats for any endangered or threatened species have been identified in the mid-Atlantic area.

CONCLUSION: OCS activities in the Mid-Atlantic Planning Area associated with the proposed action is expected to have a very low impact on threatened or endangered birds, sea turtles, and marine mammals.

CUMULATIVE IMPACTS: Under the cumulative case all species of endangered mammals, birds and turtles in the mid-Atlantic would be subject to the increase in wells (+279), amounts of drilling discharge, vessel traffic and assumed spills (+21). Local impacts could be avoided due to the migratory nature of the species and limited time present in the area. The migratory species though would be subject to oil spills and OCS activities in other parts of their routes.

The cumulative effect from all OCS activities in the Atlantic could result in a number of migratory birds such as the bald eagle or the peregrin falcons becoming fouled or ingesting fouled prey. It is unlikely that this would have an adverse impact on the population as a whole, but it may result in the mortality of individual birds that periodically inhabit the Mid-Atlantic Planning Area.

The fin, sei, sperm, humpback, and right whales, together with the leatherback and loggerhead sea turtles, occur in varying degrees in all three OCS lease areas bordering the Atlantic coast. These endangered or threatened marine species could be exposed to OCS activities over a major portion of their range. An oil spill in any region, together with all other OCS activities, could result in some adverse impacts, including the loss of a few whales and sea turtles, which could inhibit the return of each species to a nonendangered status. In the case of the right whale, the loss of any individuals could have a major impact on the population.

Impacts that are not related to OCS activities, but could contribute to a cumulative impact on all coastal avian species, would include the loss of onshore breeding, migratory stopover, and over-wintering habitats because of private and recreational development of coastal areas. The Arctic peregrine falcon migrates through Central and South America where it is exposed to toxic pesticides, such as DDT, which can drastically reduce the reproductive capabilities of these birds. Tanker spills of imported crude or refined petroleum in the region could pose a serious threat to peregrine falcon migratory stopover areas. The net effect of these impacts could inhibit the return of this species to a nonendangered status or further reduce the remaining population.

Impacts that are unrelated to OCS activities but could contribute to a cumulative impact on sea turtles in the Mid-Atlantic Planning Area include mortality caused by commercial fishermen in the Gulf of Mexico and along the southeastern coast of the United States. In 1980, approximately 1,850 sea turtle carcasses washed ashore on beaches in the south Atlantic region; presumably, the majority were killed in shrimp trawls (Federal Register, October 7, 1980). Additionally, natural and man-induced predation on adults and eggs on of all five species adds to the cumulative impact.

The high number of estimated spills over 1,000 bbl from petroleum imports may also contribute to the number of turtle mortalities. The cumulative effect of these impacts could result in additional mortalities, possibly population declines of all species. This would be especially detrimental to leatherback, hawksbill, and ridley sea turtles because of their low population sizes.

Impacts that are unrelated to OCS activities but could contribute to a cumulative impact on humpback whales in the Mid-Atlantic region include the annual subsistence level fisheries for this species in Greenland (International Whaling Commission quota of 8 in 1984-1985). Entrapment injury and mortality (17 killed in 1980) from inshore fishing gear along the Newfoundland coast is also a problem (Humpback Whales of the Western North Atlantic Workshop--New England Aquarium, Boston, Massachusetts; November 17-21, 1980). No other species of endangered whales in the Western North Atlantic Ocean have hunting quotas set by the IWC, although illegal hunting of some species may take place. The high number of estimated spills over 1,000 bbl each from petroleum imports may disrupt cetacean behavior, reduce the food supply in a localized area, and contribute to the death of some individuals. Canadian offshore oil drilling in the waters around Nova Scotia and Newfoundland also could affect endangered whales. The effects of Canadian drilling may be similar to those identified for drilling in U.S. waters. The cumulative effect of OCS activities and activities unrelated to OCS operations could result in a low number of additional whale mortalities which could inhibit the return of these animals to a nonendangered status or may even increase the risk of extinction.

CONCLUSION: The cumulative impacts of proposed and existing OCS exploration, production, and development, and non-OCS activities in the Atlantic could have a moderate impact on most endangered or threatened birds, coastal species, sea turtles, and whales. Impacts on the right whale could be high.

### (g) Impact on estuaries and wetlands

The potential impacts on estuaries and wetlands from OCS activities and oil spills are addressed in detail in Section IV.B.1.a(4)(g). The estuaries and wetlands in the mid-Atlantic area could be affected by OCS activities and oil spills in a similar manner. No significant acreage of coastal wetlands would need to be filled and developed to accommodate OCS activities in the Mid-Atlantic Planning Area resulting from the proposed 5-year schedule. An oil spill that reaches the coast would pose a threat to estuaries and wetlands. The extent of any damage would depend upon the size and weathered condition of the spill, efficiency of required oil spill cleanup equipment, and time of year of the spill. It is unlikely that the 1 assumed spill of 1000 bbl or greater in the area would have a significant impact on estuaries and wetlands considering these limiting conditions. However, an OCS tanker or barge spill in the Delaware Bay could have a significant impact because of the proximity of estuarine and wetland habitats.

CONCLUSION: A very low level of impact on estuaries and wetlands in the Mid-Atlantic is expected to result from OCS activities resulting from the proposed 5-year schedule.

CUMULATIVE IMPACTS: Oil spills from the mid-Atlantic region are not expected to have a cumulative impact on marine and coastal habitats affected by OCS activities in the north Atlantic region. However, the cumulative effect of OCS activities from both regions combined could result in the degradation of several nearshore and coastal areas ranging from Martha's Vineyard to Cape Hatteras, North Carolina. The impacts on these sensitive habitats will tend to be relatively short-lived because of the natural breakdown of oil in the marine environment and because of spill containment and cleanup operations required under OCS Operating Order No. 7. Toxic hydrocarbons that might become entrapped in bottom sediments or sink areas could pose a long-term (over 5 years) threat as oil trapped in sediments degrades very slowly and may be resuspended in the water column when disturbed. Oily sediments can have a deleterious effect on marine benthos.

Because crude oil recovered from the South and North Atlantic Planning Areas is expected to be transported to refineries in the mid-Atlantic, OCS development in these areas could have a cumulative effect on coastal habitats in the Mid-Atlantic area. A tanker carrying crude oil could have a spill in Delaware Bay or along the Delaware, Maryland, and Virginia coasts. There are numerous wildlife refuges (Federal and State) and private natural areas bordering these coastlines that could be adversely affected by an oil spill. Therefore, when OCS development in all the planning areas are considered, the potential for and the degree of impact to coastal habitats increases.

CONCLUSION: The cumulative effects of all activities will pose a high level of impact on sensitive coastal areas in the mid-Atlantic region.

### (h) Impact on areas of special concern

The areas of special concern in the Mid-Atlantic Planning Area include submarine canyons and areas of rugged topography along the shelf-break zone. A more complete description of potential impacts on canyons can be found in Section IV.B.1.a(4)(h) and can be extrapolated to the rugged areas because of their similar susceptibility to impacts. Because of the depth of the water overlying these areas (usually greater than 100m) the impacts resulting from surface oil spill are expected to be minimal and limited to sublethal effects caused by widely dispered oiled particulates sedimented to the bottom. A subsurface oil spill may cause lethal impacts to bottom-oriented individuals found in these habitats, but the affected area would not be expected to be extensive. The most likely cause of impacts to these biologically important areas would be the placement of structures and discharges of drilling materials which reach or occur at the bottom. These activities could cause extensive local mortalities because of destruction of habitat or smothering of individuals. A pervasive decline or impact on these special-concern areas on a planning-area-wide basis would not result from these activities. The one assured spill of 1000 bbl or greater is not expected to affect these areas to an appreciable extent.

CONCLUSION: The proposed action is expected to have a very low impact on areas of special concern in the Mid-Atlantic.

CUMULATIVE IMPACTS: At the present time, the impacts to areas of special concern in the Mid-Atlantic are not at a substantial level, and are generally a result of the commercial long-line and trap fisheries in the area. The potential risks to these areas are derived from existing leases -- most of which are found in or adjacent to these areas, the transportation of non-OCS petroleum, and increased fisheries activities. These potential-risk agents will not greatly increase the impact level, however some increase is expected.

CONCLUSION: A potential low level of impact is expected from cumulative sources.

### (i) Impact on marine sanctuaries

There is presently one marine sanctuary, the U.S.S. Monitor Wreck, in the mid-Atlantic area. One other site is on the Site Evalution List (SEL) and is located at Assateague Island, Virginia, and extends out to Federal waters. Because of the nature and fragility of the Monitor Sanctuary, it would be highly susceptible to mechanical damage. However, its sanctuary status precludes activities in the area. Because of the water depth involved, it is not probable that an oil spill would appreciably impact the sanctuary. See also Section IV.B.2.a.(6) regarding the deferral of this subarea from the 5-year program.

CONCLUSION: The proposed action is likely to have a very low impact on marine sanctuaries in the mid-Atlantic area.

CUMULATIVE IMPACT: Because destructive activities are not allowed in the sanctuary area, a very low level of potential impact is expected.

CONCLUSION: The proposed action combined with the potential cumulative impacts dictate an overall very low impact level.

### (5) Socioeconomic Environment

### (a) Impact on employment and demographic conditions

The search for and discovery of oil and gas resources within the Mid-Atlantic Planning Area could create employment opportunities and consequently increase population levels. These changes have both positive and negative attributes thereby giving an indication of the socioeconomic well-being of communities, counties, States, and regions.

The proposal could generate a regional total of approximately 1,000 jobs during peak activity (see Section IV.B.1.a(5)(a) for references on the methodology used to derive estimate). This total employment figure represents less than 0.1 percent of the region's civilian labor force.

A regional peak population increase of about 2,600 persons could be associated with the projected employment increase. This represents less than 0.1 percent of the region's population, implying little or no significant stress on the public and private service and facilities of the region as a whole.

The population increases generated, while minimal on a regional basis, may not be uniformly insignificant throughout the region. Impacts are potentially more significant in those counties or independent cities in which direct investments of offshore-related primary activities may be located.

CONCLUSION: The level of activity associated with the proposal will result in a very low level of impact on socioeconomic factors on a regional basis, and very low to low impact on a local basis. The only county likely to be appreciably affected is Washington County, Rhode Island where the support base facilities are expected to be located.

CUMULATIVE IMPACTS: The mid-Atlantic section of the United States is expected to decline in population as more people migrate toward the southern and western parts of the United States. The typical blue collar industries will continue to provide fewer job opportunities as more light industry, high technology firms replace traditional manufacturers. Therefore, oil and gas development on the outer continental shelf will provide a stablizing effect by providing employment opportunities to occupational groups that would otherwise have reduced employability.

Population in the planning area is expected to decline by 6 percent by the year 2000 from the 1980 census figure of 23,677,097 (Department of Commerce, Bureau of the Census, 1983). This continues a trend that began in the 1970s and is characteristic of the out migration of people toward the southern and western portions of the United States.

CONCLUSION: Development in the planning area is expected to shift toward light industry, high technology. A declining employment and population base will be looking for employment opportunities as they become available. Impacts to the planning area are considered low.

### (b) Impact on coastal land uses

The nature of the scenario for the Mid-Atlantic Planning Area and an explanation of assumptions is contained in Section IV.A. Major onshore components of the scenario for the midAtlantic include a new gas pipeline and landfall, a new gas processing and treatment plant, and existing support base facilities in Davisville, Rhode Island. This support base is the same facility which will serve the North Atlantic Planning Area. No assumption has been made at this time with respect to the pipeline right-of-way and the location of the gas plant for the mid-Atlantic. Previous EISs for mid-Atlantic lease sales have analyzed the potential land-use impacts from pipeline landfalls and rights-of-way for Little Compton, Rhode Island; Sea Girt, New Jersey; Bethany Beach, Delaware; and Virginia Beach, Virginia. Although such locations would have varying degrees of environmental impacts, all were found to be acceptable if certain conditions could be met and environmental impacts mitigated. For example, a pipeline landfall and right-of-way in New Jersey would be subject to review by two principal State Agencies, the New Jersey Department of Energy (NJDOE) and the New Jersey Department of Environmental Protection (NJDEP). Several potential pipeline routes for OCS oil or gas have been examined by the NJDEP (see NJDEP, 1980; and Rogers, Golden, and Halpern, 1981). In identifying the least environmentally harmful alternative, the study determined that what environmental effects would occur could be "reduced to acceptable levels by proper planning and appropriate construction methods." The pipeline would be routed to a nearby processing plant (see below) and thence to existing pipeline systems.

A gas processing and treatment plant is also hypothesized for the successful exploration and development of the mid-Atlantic OCS. The exact location of this plant would depend upon where in the sale area the gas resources are discovered. Previous mid-Atlantic sale scenarios have analyzed hypothetical locations in Bristol County, Massachusetts; Monmouth County, New Jersey; New Castle County, Delaware; and Norfolk, Virginia. The reader is referred to sale-specific EISs for more detailed analysis. Coastal sites, although not necessarily on the waterfront, are preferred for gas plants which would consume approximately 50-75 acres. In the absence of more specific information regarding facility requirements and proposed locations, it is anticipated that there are ample industrially zoned lands in the coastal mid-Atlantic to accommodate a gas processing and treatment plant within the context of environmentally sound land-use planning.

The facilities needed for an OCS support base are currently in place in Davisville, Rhode Island. This support base has serviced all exploratory activities in the north Atlantic and mid-Atlantic to date. Section IV.B.1.a.(5)(b) analyzes the facility with respect to land-use issues for the north Atlantic. No major conflicts are anticipated if it remains the mid-Atlantic support base for the OCS activities associated with this 5-year program.

It is assumed that existing facilities serving the Gulf of Mexico will fulfill the pipecoating requirements for the proposed action. Oil produced in the mid-Atlantic will be transported by tanker to existing refineries in the Delaware Bay area. No oil pipelines are anticipated.

Expansion of neither the pipecoating facilities nor the refineries will be required. Helicopter services can be located in any existing commercial airport along the coast and would not require expansion of facilities. Because these requirements can be met by existing facilities without expansion, no conflicts with land-use plans or policies are anticipated.

CONCLUSION: The components of the OCS exploration and development, particularly the gas pipeline and treatment plant, are expected to have moderate impacts on land use in mid-Atlantic coastal areas. All proposed activities and facilities are expected to be sited in generally compatible areas. Detailed siting approval and procedural requirements are expected to mitigate the impacts which may occur.

CUMULATIVE IMPACTS: The proposed action, when combined with other reasonably foreseeable actions, has the potential for cumulative impacts which would be generally the same for mid-Atlantic as for the North Atlantic Planning Area (see Section IV.B.1.a.5.b). This includes the potential for unplanned and uncontrolled development resulting in considerable damage to coastal resources. A variety of efforts, including land-use plans and coastal management programs, if successful, will prevent or lessen such damage.

CONCLUSION: Impacts on land use in the coastal zone could be high or very high in the cumulative case. However, adherence to coastal zone management programs, other policy programs, and local land-use plans should help reduce these impacts.

### (c) Impact on commercial fisheries

The major commercial fisheries in the mid-Atlantic area tend to be inshore or near-coastal and would most likely not be appreciably affected by the proposed action. The various generic types of potential impacts on commercial fisheries are discussed in Section IV.B.1.a(5)(d), and the potential impacts on fish resources are discussed in Section IV.B.2.a(4)(i). These would generally apply also to the region.

The most probable impact on commercial fisheries would be exclusion of bottom trawls or shellfish dredges from areas where oil and gas structures are sited. The major structure which would be involved would be the assumed gas pipeline. The gas trunkline would exclude commercial bottom fisheries from a maximum of 260 sq.km. (200 mi2, 26,000 hectares) or approximately 0.3 percent of the shelf area. Because of the general mobility of most of the commercial species, individuals are assumed to move away from this refuge zone and become available to capture. Therefore, the overall impact, as a result of spatial exclusion, is expected to be much less than a linear 0.3 percent decrease in catch. Although of low probability, an oil spill could occur at the peak spawning time of some commercial species. Because of the migratory nature of most of the commercial fish species in the mid-Atlantic area and the broad dispersion of spawning activity, the impact from even a large spill is expected to be of a low level.

CONCLUSION: The overall impact on commercial fisheries as a result of the proposed action is expected to be low.

CUMULATIVE IMPACTS: The major cause of impact on commercial fisheries is overfishing the resource. The tilefish and striped bass fishery is an example of drastic declines in stocks after peak landings were once obtained. By 1983, both species were overfished.

Emplacement of 14 platforms and one pipeline resulting from the proposed action, combined with increased support vessel traffic and fishing port conflicts in the form of competition for repair and docking space would further constitute adverse impacts on the commercial fisheries.

An additional major threat to the commercial fishery is the potential for the 21 spills greater than 1,000 bbl estimated to occur as a result of the present transport of petroleum hydrocarbons through the planning area. This represents a much more likely source of a spill large enough to cause a severe impact on fisheries than the proposed action because of the quantity of the more toxic refined fraction transported and the probability of a spill occurring.

CONCLUSION: The cumulative impact on commercial fisheries is estimated to be high, and the proposed action will not modify this level.

### (d) Impact on recreation and tourism

Land-use competition, visual effects, and oil spill impacts are the three major concerns relating to recreation and tourism in the coastal mid-Atlantic. The nature of such concerns are examined in some detail in the north Atlantic section on "Impacts on Recreational Resources" [Section IV.B.1.a(5)(d)]. Much of the information and conclusions contained therein is equally applicable to the affected States of the Mid-Atlantic Planning Area.

The scenario for exploration and development of the mid-Atlantic OCS call for a new gas processing and treatment plant and a gas pipeline right-of-way and landfall. Previous EISs for mid-Atlantic lease sales have analyzed Little Compton, Rhode Island; Sea Girt, New Jersey; Bethany Beach, Delaware; and Virginia Beach, Virginia and nearby areas as potential pipeline landfalls and gas plant sites. It has been determined that ample locations are available in the coastal mid-Atlantic to accommodate such facilities. These and other onshore facilities supporting offshore oil and gas activities can be accommodated without necessarily conflicting with coastal recreation. In addition, any onshore facilities would be sited in accordance with applicable Federal, State, local, and coastal zone land-use policies [Sections IV.B.2.a(1)(c) and IV.B.2.a(5)(b)]. It is thus unlikely that any such facilities would be sited in an area used or suitable for coastal recreation.

As detailed in Section IV.B.1.a(5)(d), unless offshore facilities are located in the most shoreward portions of the planning area (at least 3 miles offshore), which is unlikely, the potential for onshore visual impacts from OCS exploration in the Mid-Atlantic Planning Area is quite small or nonexistent.

The potential for oil spill impacts to coastal recreation is also quite small, even with the assumption that a spill resulting from the proposed action will occur in the Mid-Atlantic Planning Area. The bulk of what risk does exist is the product of potential nearshore tanker spills or potential accidents from the very unlikely placement of production facilities in nearshore areas. With the assumed transportation of north and south Atlantic OCS oil production through the mid-Atlantic to Delaware Bay, coastal recreation resources in the Delaware Bay area face a greater risk of nearshore tanker spill contact than other coastal areas in the region.

It should be noted, however, that although the scenario for the proposed action includes tanker routes, the risks associated with spills from these routes exist regardless of the sale. These risks are from spills associated with ongoing transportation of foreign and domestic crude and refined products through the area, unrelated to Atlantic OCS activities.

CONCLUSION: The proposed action's impacts on coastal recreation and tourism are anticipated to be very low. Although certain local areas may experience low or possibly moderate impacts in the unlikely event of oil spill contact, overall impact on the region should remain very low.

CUMULATIVE IMPACTS: Long-term development pressures may create land-use conflicts with recreational resources. It is anticipated however that State and local land-use plans and policies and coastal zone management programs will be effective in controlling development and reducing conflicts.

In the cumulative case, existing levels of tanker transportation of crude oil and refined products through the area (levels which are expected to continue) create substantially greater risk of oil spillage and a resulting greater likelihood of spill contact with coastal recreation resources. There is a greater than 99% chance of one or more spills ($\geq$1000 bbl) in the mid-Atlantic in the cumulative case with an expected number of spills calculated to be 21.56 (Table IV.A.4.a.2).

Although certain local areas may be adversely affected by an oil spill if one should occur, tourism and recreation is a well established industry in the coastal mid-Atlantic area and is expected to remain as such. There are no predictable factors, including OCS activities, which are anticipated to depress the tourist industry or displace its role in the area's economy.

CONCLUSION: In the cumulative case, the potential exists for high impacts to coastal recreation areas. These impacts, resulting from oil spills, would tend to be local in nature, not extending over the region as a whole.

### (e) Impact on archaeological resources

#### (i) Prehistoric archaeological resources

Prehistoric archaeological resources include aboriginal artifacts (such as stone bowls and tools), which may occur singly or in clusters, and habitation sites either onshore or offshore. Approximately 10 percent of the Mid-Atlantic Planning Area is estimated to have a medium-to-high probability of containing prehistoric archaeological artifacts.

OCS oil and gas activity may have both negative and positive impacts on prehistoric archaeological resources. During the geophysical and geological evaluation phase of exploration activities, both positive and negative impacts are possible. Seismic surveying and bottom sampling may result in identification of previously unknown sites thus providing a benefit to archaeological research. On the other hand, bottom sampling could also result in the disturbance of buried resources. Because archaeological interpretation is heavily dependent on the relative placement of artifacts within a site, such disturbances could be very damaging.

The majority of possible impacts during the exploration and development phases are negative in nature. Rig and platform installation could disturb both surface and buried resources. Drilling muds, cuttings, and fluids may damage sites by means of chemical activity but also could afford protection by burying the site.

Based on information obtained from pre-drilling surveys, lessees would be able to take actions which would avoid or lessen many potentially negative impacts on prehistoric archaeological resources. In some cases, however, indicators of archaeological sites (e.g., shell middens) are sometimes hard to detect and therefore adverse effects of oil and gas activities may result.

If blocks within the zones of greatest archaeological potential are leased, prehistoric resources which may be present in those blocks could be affected by oil and gas activities. However, because there are no known prehistoric sites in this area, it is very difficult to quantify the expected level of impact.

Nevertheless, only a small percentage of the Mid-Atlantic Planning Area is within the zone of medium-to-high archaeological probability. Also, only a low level of activity is projected with only 1 platform assumed in the mean case scenario. Consequently, the overall impact of the proposal on prehistoric resources occurring within the area is expected to be low. In addition, only 1 gas pipeline is projected for the planning area. However, should an archaeological site be located within the pipeline corridor, damage to or destruction of the resource could occur unless the site has been buried through deposition of sediment. Environments capable of such burial include the marsh-lagoon barrier system and the floodplain-marsh estuary system. This would minimize danger to the potential sites.

Prehistoric sites located in tidally influenced areas, on the other hand, could be severely affected by an oil spill. Oil could contaminate prehistoric artifacts and oil spill cleanup operations could disturb or destroy artifacts. Construction of processing and storage facilities at onshore locations could result in the damage or destruction of prehistoric archaeological resources. However, the probability of this occurring is remote as State and environmental regulatory agencies have opportunities to review plans for onshore development related to offshore oil and gas activity.

### (ii) Historic archaeological resources

Historic archaeological resources include shipwrecks, or sunken aircraft offshore, and historic buildings, sites, bridges, or districts onshore.

The potential for impacts on historic archaeological resources in the Mid-Atlantic Planning Area is greatest in the shipping lanes east of Raritan Bay. This is an area of moderate shipwreck concentration. A heavy concentration of shipwrecks exists off Cape Hatteras at the southern limit of the planning area. Small concentrations of shipwrecks exist in Block Island Sound and between Delaware Bay and Raritan Bay.

Potential impacts on shipwrecks are both positive and negative in nature. As with archaeological artifacts, exploratory activities might result in identification of previously unknown wrecks. However, the magnetic signature of the dispersed remains of a shipwreck could easily be masked by a platform or pipeline near the shipwreck. Any objects placed on the ocean floor may crush a fragile wooden wreck. Finally, spilled oil could contaminate a shipwreck and oil spill cleanup operations could damage or destroy a wreck.

Many potentially negative impacts on historic archaeological resources could probably be avoided through the use of information obtained during pre-drilling surveys. Shipwrecks could be located through pre-drilling surveys required under OCS Operating Order No. 2, and, once identified, could be avoided by means of directional drilling and other techniques.

Because shipwreck data are rather limited, it is very difficult to quantify the expected level of impact. However, areas known or expected to contain heavy concentrations of shipwrecks are rather limited within the planning area. Also a low level of activity is projected for the planning area with only 1 platform assumed in the mean case scenario. Consequently, the overall impact of the proposed lease sales on historic resources is expected to be low.

If a shipwreck is located in the path of a natural gas pipeline, damage to or destruction of the resource could occur. However, before a pipeline route is actually chosen, a survey would be required. Such surveys, conducted with sidescan sonar, sub-bottom profiler, and possibly magnetometer, could locate many shipwrecks which might be present in the proposed corridor. The pipeline could then be realigned in order to avoid possible conflicts.

Because the majority of historic structures in the immediate tidal zone are protected by bulwarks or other barriers, damage from an oil spill would be largely esthetic in nature. Additionally, any historic sites eligible for or listed on the National Register of Historic Places are afforded protection under the National Historic Preservation Act of 1966, as amended. The siting of OCS-related facilities at onshore locations could adversely affect historic archaeological resources. However, because State and environmental regulatory agencies have opportunities to review plans for onshore development related to offshore oil and gas activity, the probability of this occurring is very remote.

CONCLUSION: Impacts on archaeological resources located within the planning area, in onshore areas, and along pipeline rights-of-way are expected to be low.

CUMULATIVE IMPACTS: While in the cumulative case there are expected to be 14 platforms and 35 work boats, activities not associated with OCS oil and gas development would appear to present a higher probability of negative impact on archaeological resources, both prehistoric and historic, within the Mid-Atlantic Planning Area. Such activities include the transport by tanker of crude and refined petroleum imports through the region, onshore facility construction, trawling, sport diving and commercial treasure hunting, and channel dredging. Because there is a greater probability of an oil spill resulting from the continued importation of oil at present levels, historic shipwrecks and/or prehistoric sites could be contaminated by an oil spill. Subsequent cleanup operations could damage or destroy the wrecks and/or sites. Construction of non-OCS-related onshore facilities could result in the damage or destruction of both prehistoric and historic archaeological resources. However, the impacts could be mitigated through compliance with a variety of permitting requirements, the coastal zone management programs of the affected States, and the National Historic

Preservation Act of 1966. Because trawling by fishermen would affect only the uppermost portion of sediments, the risk to potential prehistoric sites would be low. With respect to historic shipwrecks, it is likely that the zone of disturbance would have already been affected by natural forces. While sport and commercial diving would probably have little impact on potential prehistoric sites, the removal of artifacts from shipwrecks could be very damaging. Because most channel dredging takes place near the entrance to inlets and ports, both prehistoric and historic resources could be severely affected by such activities. This is because areas near the shoreline generally have a higher probability of containing archaeological resources than do areas further offshore. However, a mitigating measure would be the U.S. Army Corps of Engineers (COE) requirements that remote sensing surveys be conducted prior to dredging operations in many areas.

CONCLUSION: Impacts on archaeological resources could range from moderate to high because of the aggregate of varied activities occurring within the planning area.

### (f) Impact on marine vessel traffic and offshore infrastructure

Generic impacts on marine vessel traffic and offshore infrastructure (e.g. oilrigs, production platforms, and pipelines) resulting from OCS oil and gas activities are described in Section IV.B.2.a(5)(h). Traffic Separation Schemes (TSSs) and Precautionary Areas have been established in the mid-Atlantic at the approaches to Narragansett Bay, Buzzards Bay, New York Bay, Delaware Bay, and Chesapeake Bay. Although there are no formal restrictions concerning the placement of structures within TSSs, International Maritime Organization (IMO) guidance recommends that lanes remain free of obstructions. The Coast Guard does not usually approve siting structures within traffic lanes or within a 500-m buffer zone on either side of both the inbound and outbound lanes. Alternatively, traffic lanes can be temporarily shifted or suspended to permit exploratory drilling in areas which would otherwise be off limits. However, it is unlikely that exploration activities will take place within the mid-Atlantic TSSs or Precautionary Areas as these areas are of low interest to the oil and gas industry. In addition, only 1 production platforms is projected for the mid-Atlantic in the mean case scenario and only 3 supply boats will be servicing these platforms. Therefore, it is anticipated that all parties concerned with vessel traffic will be able to adjust to the slightly increased level of vessel traffic and to the siting of structures within the planning area.

CONCLUSION: The impact on marine vessel traffic and offshore infrastructure is expected to be very low.

CUMULATIVE IMPACTS: With 14 platforms and 35 work boats the vessel activity and structure placement associated with the cumulative case represents a small percentage of all activities that may have an impact on marine vessel traffic and offshore infrastructure. Because the mid-Atlantic is an area of especially heavy vessel traffic, there is always the potential for vessel collisions even without OCS leasing. Commercial vessel traffic presents the major source of potential navigational hazards. Current collision and accident rates are low but are expected to increase in frequency, regardless of oil and gas activities, because of expected increases in commercial shipping.

CONCLUSION: A low level of impact on safe navigation is expected because of heavy vessel traffic primarily unrelated to OCS oil and gas activities.

### (g) Impact on military uses

The proposed action will create a conflict between oil and gas activities and NASA activities associated with the Wallops Island Flight Test Center, Wallops Island, Virginia. The Wallops Island NASA Warning Area delineates the minimum area that NASA feels must be kept free of all surface structures. The portion of the warning area that is included in the proposed action represents only a very small percentage of the planning area. Based on the resource estimates and the production schedule for the proposed action, it is estimated that only 1 platform would be in the surface-free zone at any time (Figure III.A.2.a.6-1).

Any vessel or structure within this area would be subject to the remote possibility of being damaged by falling debris resulting from both successful and unsuccesful rocket and missile launches. If a rig or platform were damaged by debris from a rocket or missile, an accidential release of hydrocarbons could occur if wells and other equipment were not shut in. The shutting in of wells and other equipment during each launch would appear to be impractical because of the frequency of launches (approximately 20 per month).

The proposed action will also create conflicts between offshore oil and gas activities and DOD activities in the Mid-Atlantic Planning Area. These conflicts include such matters as offshore operators emissions of electromagnetic signals affecting missile firing events; ship and aircraft traffic interfering with both naval and air training exercises; and the possibility of collision between both submarines and missiles with offshore oil and gas surface or subsurface structures.

CONCLUSION: The level of impact on military uses and NASA activities resulting from the proposal is expected to be low.

CUMULATIVE IMPACTS: The proposal represents only a small percentage of the activities taking place within the Mid-Atlantic Planning Area that may conflict with planned military operations and training and NASA activities. To date, however, little or no serious conflicts have arisen between oil and gas or other activities and the military and no conflicts are expected.

CONCLUSION: Cumulative impacts are expected to be low.

### (6) Subarea Deferrals

The following subarea is proposed to be deferred from leasing in this 5-year program.

### National Marine Sanctuary-U.S.S. Monitor and Buffer Zone

The U.S.S. Monitor National Marine Sanctuary lies approximately 16 miles southeast of Cape Hatteras in Blocks NI 18-2, 939 and 983. Other sites on the site evaluation list include the Virginia/Assateague Island Area due east of Assateague Island.

The area is the site of the historical wreck of the ironclad U.S.S. Monitor. Although this is a fairly high energy area, some attached epifaunal and epifloral species are present. A single colony of the scleractinean coral, *Oculina arbuscula*, has been reported on the wreck, which is apparently its northern limit. The Virginia/Assateague Island site is typical of the inshore areas found in the mid-Atlantic. The fauna is dominated by mollusks, annelids, and the primarily migratory fish that seasonally move through the area.

OCS exploration activities which might raise concern about the stability and security of the U.S.S. Monitor wreck include high resolution profiling, disposal of drilling muds and cuttings, structural placements on the ocean floor, and oil spills. None of these activities, however, pose any substantial threat to the U.S.S. Monitor. High resolution profiling in the area of the Monitor site has not been shown to accelerate deterioration of the wreck. Disposal of muds and cuttings from drilling platforms, if located in proximity to the Monitor wreck could increase the sediment load to the site. Chances are very remote that a surface oil spill could be entrained in the water column deeply enough to affect the U.S.S. Monitor site, however a subsurface blowout could pose a substantial risk to the marine sanctuary. No substantial change in water quality impact would occur. Deferral of this subarea ensures that none of the activities described above nor the resulting potential impacts will occur within the sanctuary and buffer zone.

### b. Unavoidable Adverse Impacts

Normal offshore operations associated with exploration, development, and production of hydrocarbon resources result in unavoidable adverse effects of varying degrees on water quality, plankton, benthic organisms, shellfish, finfish, commercial fisheries, marine and coastal birds, some endangered or threatened species, marine mammals, as well as coastal habitats. Conflicts with regard to land use planning also occur.

The discharge of drilling muds and cuttings would cause localized, temporary increases in suspended solids and accompanying trace metals in the immediate vicinity of drilling rigs. Discharged formation waters would cause localized, minor elevations in inorganic salts, trace metals, and hydrocarbon levels around platforms, with correspondingly reduced oxygen levels.

Oil spills and chronic discharges of oil would temporarily increase hydrocarbon levels in the water column. Oil released to the environment would disperse, undergo weathering, and in shallow areas could become entrained into the bottom sediments. Sewage discharges from rigs and platforms would increase local levels of suspended solids (organic matter), BOD, nutrients, and chlorine. Finally, temporary turbidity of the water column would be increased by pipeline placement which would cause resuspension of sediments.

It is assumed that 1 spill of 1,000 bbl or greater would occur as a result of the proposal. The quality of the surface, near-surface, and, to a lesser extent, deeper waters would be lowered temporarily by spilled oil that is not recovered. If oil is entrained in bottom or shoreline sediments, water quality degradation could continue over weeks, months, or even years as the oil is slowly reintroduced into the system or biodegraded.

Minor, temporary decreases in benthic and planktonic populations would occur in localized areas around drilling rigs because of the disposal of drilling muds and cuttings. Toxic materials used in mud mixtures may adversely affect some marine organisms in localized areas when drilling fluids and cuttings are discharged and settle to the bottom. Also, bottom sediments and biota would be temporarily disrupted by pipelaying operations.

Commercially important species may be affected by mortality to fish eggs and larvae and smothering of shellfish. Commercial fishermen would be negatively affected by spatial exclusion from fishing grounds. Additionally, possible damage to gear and lost fishing time could occur. Spilled oil would cause localized mortalities of finfish and shellfish, particularly at early stages of their development.

Endangered or threatened species, including marine mammals, are not expected to suffer any major adverse impacts to their remaining populations. However, it is possible that some individual animals might be adversely affected from activities or accidents related to the proposed action. Marine and coastal birds could suffer minor losses. Sensitive coastal areas (i.e., wetlands, estuaries, and sandy beach/dune areas) could take several years to recover from oil spill impacts.

A gas pipeline landfall would cause a temporary and local disturbance of beach and wetland habitats during the construction phase. Unavoidable conflicts with land-use planning resulting from pipelaying and related disturbances would be localized and temporary in nature. The single projected gas pipeline would require onshore rights-of-way and would be buried. Approximately 75 acres of land would be needed for the construction of a gas processing plant.

### c. Relationship Between Local Short-Term Uses of the Environment and the Maintenance of Long-Term Productivity

Short term is defined as the projected economic life of the project, and long term is defined as the period that follows the economic life of the project. The principal short-term use of the area would be for the production of oil and gas which are non-renewable resources.

Short-term adverse effects to marine biological communities would result from normal operations and oil spills. Short-term losses could include reductions in biological productivity, changes in marine habitats, reductions in populations of plankton, benthos, fish, birds, mammals and turtles, and changes in food web components.

After the project, impacts resulting from OCS activity in the proposed sale area would not occur. To date, there has been no discernible decrease in marine productivity in OCS areas where oil and gas have been produced for many years. It has been recognized that continuous, low level pollution from toxic chemicals, including oil, may adversely affect long-term productivity, but the extent of these long-term effects cannot be quantitatively determined until reliable data become available.

Of the species in the region protected by the Endangered Species Act, marine species may suffer some short-term adverse effects. Coast oriented endangered species probably would not be affected significantly. Important feeding and breeding areas for endangered whales are currently believed to be located outside the sale area. If, in the future, breeding areas are located in the region, OCS activities may have an adverse short-term and long-term effect on breeding success. Migrating whales must pass through the proposed sale area. Sale-related activities could lead to changes in the migratory behavior of these whales. Non-endangered marine mammals would suffer only short-term effects from the proposed action.

The proposed sales will result in employment and population increases and possible short-term adverse impacts to the social infrastructure of affected communities. A strain on existing public and private services could be expected if new OCS-related facilities are located in areas of low population with little current industrial base. However, in the long term, a return to equilibrium can be expected as population gains and indirect industrial development are absorbed into the expanded communities.

Short-term adverse impacts could occur to the recreation resources and tourist industry of the area if an oil spill contacted a beach during or just prior to the season of peak use.

Short-term use of the OCS for mineral extraction would preclude fishing in the immediate vicinity of oil and gas operations. Although fishing takes place within the proposed lease area, only a small portion of the total fishing area would be removed.

In summary, short-term, localized impacts, both environmental and socioeconomic, would result from the proposed sales. No long-term productivity or environmental gains with regard to natural resources are expected as a result of the proposed sales. Benefits are expected to be principally those associated with increased domestic supplies of oil and gas and lessened dependence on foreign sources.

### d. Irreversible and Irretrievable Commitment of Resources

Development and extraction of hydrocarbons could represent an irreversible and irretrievable commitment of nonrenewable oil and gas resources. The conditional mean resource estimates for the proposed sales are 25 million bbl of oil and 419 BCF of natural gas.

An irreversible or irretrievable commitment of biological resources and their habitats could occur in the area of a massive oil spill, or nearby areas that are subjected to chronic low levels of pollution. However, it is anticipated that an affected area would recover from a spill and that the natural flora and fauna would eventually reoccupy spill areas. Exceptions could be an irreversible or irretrievable loss of an endangered species that may result if populations of such a species are affected by an oil spill, either directly or through food contamination, or by any other disruption or disturbance such as habitat loss that may result from the proposed action.

Human deaths and permanent disabilities from OCS offshore operations are an irretrievable loss of human resources.

The proposal would require land for a right-of-way for 1 natural gas pipeline and associated processing facility. Additional land for facilities stimulated in part by the proposed action could also be required. Energy expended and equipment used in exploring for and transporting oil and gas reserves could constitute an irreversible and irretrievable commitment of resources.

A decision to proceed with the proposal would result in the production of certain OCS-related goods and services. To the extent that resources would be drawn away from other uses, production of goods and services in other areas or of other types would be foregone.

### e. High Resource Estimate Scenario

Introduction

Economically recoverable resources under the high resource estimate scenario for the Mid-Atlantic Planning Area are estimated at 200 mmbbl of oil and 3.350 tcf of gas (Table IV.A.1-3). This is approximately 8 times the resource estimate for the base case. Exploration in this high resource scenario would begin in 1990 with the most intense exploratory activity occurring between 1992-1993. Exploration activities are projected to cease after 1995. The first year of development/production wells and platforms is anticipated to be 1993 followed by periods of most activity in 1997 for development/production wells and 1995-1997 for platforms.

The high resource estimate scenario calls for 67 exploratory and delineation wells, 91 development/production wells, and 7 platforms. This is 7-8 times the number of facilities projected for the base case scenario. Oil produced under the high resource scenario would be loaded onto tankers from platforms or from single-point moorings connected by gathering lines to subsea complexes and transported to refineries in the Delaware Bay area. Gas produced under this scenario would be gathered by small diameter gathering pipe and fed into one trunkline for transport to an onshore gas processing and treatment plant in the mid-Atlantic area.

Gas facilities: One gas processing and treatment plant is projected to be associated with the development of Mid-Atlantic OCS resources. It is anticipated that such a facility would be designed and built to accomodate the high resource estimate should such resources be discovered. As in the base case, no assumption has been made at this time as to the specific location of this facility.

Support bases: This high resource estimate scenario includes utilization of support base facilities at Davisville, Rhode Island, as described in the base case scenario for the North Atlantic Planning Area, and/or new facilities possibly in the Morehead City/Beaufort area of North Carolina.

Platform fabrication and pipecoating: All platform fabrication needed under the high resource scenario will most likely occur at existing fabrication facilities in the Gulf of Mexico Region. In addition, numerous suitable facilities for pipecoating are located in the Gulf of Mexico Region and could be utilized if needed.

### (1) Physical Environment

#### (a) Impact on water quality

Types of water quality impacts resulting from high case resource development would be the same as those described for the base case proposed action. The magnitude of these impacts, however, would be greater as the number of wells and platforms would increase approximately seven-fold (to 158 wells and 7 platforms) (Table II.A.1-3) of that assumed for the proposed action. Consequently, the total volume of routine discharges released over the exploration and production period for the 1 sale would increase proportionately (to 2.6 million bbl of drilling muds; 0.7 million bbl of drill cuttings; 160 million bbl of formation waters; 116 million gallons of sanitary waste; 348 million gallons of domestic waste). However, the volume of these waste materials would still be small compared to the large volume of the receiving water. Impacts would be of a generally limited and local nature as discussed in Section IV.B.1.a.(2)(a). The materials would be rapidly dispersed or diluted, and their discharge would take place within a geographically large area, spaced over a long period of time--9 years for drilling of wells and 30 years for resource production. Because of these factors, impacts on water quality from these routine discharges would be temporary and minor in nature.

The assumed number of large (> 1,000 bbl) accidental oil spills under high case resource development is one--this being the same as for the proposed action. Also, no new additional support facilities which may affect onshore water quality are anticipated.

CONCLUSION: A low, overall impact on water quality is anticipated from high case resource development.

#### (b) Impact on air quality

Air quality impacts characteristic of potential OCS activities and the regulatory framework for pollutant emissions are reviewed in the section on air quality (IV.B.2.a(3)(b)). Major impact producing factors on air quality from OCS-related activity are the combustion of raw material, evaporative losses, internal combustion related to power generation, and refinery/processing techniques. Resource estimates in the high resource estimate scenarios for the mid-Atlantic are more than seven times higher than the base case scenario, resulting in an increase in OCS activities associated with the exploration and development of these oil and gas resources. The increased OCS activities, including exploratory drilling vessels, and an onshore gas processing and treatment plant, may raise the overall level of pollutant emissions in the region. However, facilities used for exploration, development and production of OCS oil and gas are subject to DOI air quality regulations, and, when applicable, the State Implementation Plans for attaining compliance with National Ambient Air Quality Standards under the 1977 Clean Air Act Amendments (see Section IV.B.2.a(3)(b)). As a result, only a marginal increase in pollutant emission levels would be anticipated in the high resource estimate scenario compared to the base case.

CONCLUSION: Under the high resource estimate scenario, impacts on air quality for the mid-Atlantic may increase to moderate from the low level anticipated for the proposal.

### (2) Biological Environment

#### (a) Impacts on plankton

The generally wide-spread distributions of mid-Atlantic plankton communities precludes appreciable impacts from a regional perspective. The increase in drilling discharges under the high case will not affect the plankton community except in a very localized area. Any local decrease in population would not be distinguishable from the natural contagious distributions of the species. The major risk of impact results from potential oil spills. Under the high-case scenario, the production level does not increase significantly, the assumed number of oil spills is still one, thus, no increase in impact level is expected.

CONCLUSION: The high-case impact level is expected to be low.

#### (b) Impacts on benthos

##### (i) Intertidal

Changes under the high resource estimate scenario from the proposed action [Section IV.B.1.a(4)(a)] will not add to or increase the causes of impact, such as the number of pipelines or oil spills, on the intertidal benthos. Therefore, no change in impact levels on benthic organisms is expected.

##### (ii) Subtidal

Under the high resource scenario a three-fold increase in the number of wells to be drilled is projected. This will increase the quantity of drilling discharges to approximately three times the amount estimated under the proposed action. Displacement or burial of benthos because of the additional wellheads and drilling discharges will increase. Effects, though, are expected to be very local, short-term, [Section IV.B.2.a.(4)(b)] and occur over a 14- to 20-year development period. Multiple well drillings in canyon areas, however, would cause moderate impacts. The assumed number of oil spills of 1,000 bbl or greater remains at 1 the same as the proposed action. Therefore, there will be little changes from proposed action impact levels on benthic organisms on a regional basis.

CONCLUSION: A low level impact on benthos could be expected under the high resource estimate scenario.

#### (c) Impact on fish resources

Section IV.B.2.a(4)(c) should be referred to as a source of generic information for potential impacts on fish resources as a result of OCS oil and gas activities.

The proposed action with high-case estimates would not appreciably increase the potential impacts to fish resources. The greatest increase in impacts would result from the increased number of wells which would be required. The additional wells, however, would be distributed over a number of years during the development period thereby lessening the possible local impact. Generally however, the impacts resulting from well placement and the discharge of materials from the additional wells represent a minimal threat to the highly mobile and generally migratory mid-Atlantic fish species or their egg and larval stages. The assumed number of oil spills--the major agent of potential impact--does not change from the mean case and remains at 1. Therefore, no increase in impact level is expected.

CONCLUSION: A low level of impact under the high-case estimates is expected. IV.B.2.m.

#### (d) Impact on marine mammals

Under the high resource case, there will be an increase from 1 to 7 platforms and a three fold increase in the number of wells and amount of drilling discharges. The source of greatest potential impact, the assumed 1 oil spill, remains at 1 in the high case. The increases seen in the high case are not anticipated to create a noticeable effect on mid-Atlantic marine mammals. The effects from an assumed oil spill are discussed in Section IV.B.2.a(4)(d) and will remain the same.

CONCLUSION: The high resource scenario is expected to have a low impact on nonendangered marine mammals.

#### (e) Impact on coastal and marine birds

The Mid-Atlantic Planning Area is used primarily during the migratory periods of these birds. Under the high case, the number of platforms, wells, and drilling discharges would increase, but the numbers are still small considering the size of the planning area and the volume of the receiving waters. No additional gas trunklines, processing facilities or onshore support bases would be needed under the high case. The 1 assumed oil spill could affect seabirds if they came in contact with it. This is unlikely however, because of the low number of birds and the short time they spend in the area.

CONCLUSION: Low impacts on seabirds under the high case are expected.

### (f) Impact on endangered and threatened species

The species of endangered or threaten birds, sea turtles, and marine mammals inhabiting the Mid-Atlantic are essentially the same as those in the north Atlantic area. Therefore, the same types of OCS-related impacts identified in Section IV.B.1.a(4)(f) could occur in the Mid-Atlantic.

The Mid-Atlantic Planning Area is important to migrating peregrine falcons and nesting bald eagles. OCS activities associated with the high resource case should not affect endangered or threaten birds because no additional onshore support facilities would be constructed and the number of assumed oil spills remains at 1. No conflicts with breeding or migratory stopover areas are anticipated.

The mid-Atlantic is an important summer feeding ground for endangered or threaten sea turtles, especially the loggerhead. Also, turtles are thought to be attrached to platforms, increasing possible contact with the increased number of service vessels.

Though discharges would increase in quantity under the high case, the discharge rate per platform would remain the same. Platforms are thought to act as reef-like structures attracting turtles in search of food. Attracted turtles will be in greater danger of being struck by the increased number of service vessels.

Volumes of discharges and the number of wells are expected to increase three-fold. The level of drilling activity and support vessel traffic under the high case should not seriously interfere with breeding, feeding, or migrating activities of the whales in the Mid-Atlantic because they are accustomed to heavy human use of the area. The 1 assumed oil spill is not likely to have a direct impact on any healthy individuals that can move away from contaminated areas. Sick animals and juveniles could experience more serious effects. The size of the planning area and the seasonal movements of each species would further reduce the odds of contacting an OCS oil spill. No preferred areas or critical habitats for any endangered or threatened species have been identified in the Mid-Atlantic area.

CONCLUSION: Impacts on threatened or endangered birds, sea turtles, and marine mammals are expected to be at a moderate level.

### (g) Impact on estuaries and wetlands

Refer to Sections IV.B.1.a(4)(g) and IV.B.2.a(4)(g) for a discussion of potential impacts on estuaries and wetlands. There is expected to be no change in potential impacts from the mean-case to the high-case proposed action. This is primarily a result of the assumed number of oil spills--the major agent of impact on these systems--being 1 under both scenarios.

CONCLUSION: A very low level of impact on estuaries and wetlands is expected under the high-case proposed action.

#### (h) Impact on areas of special concern

The areas of special concern in Mid-Atlantic including existing and proposed National Estuarine Sanctuaries. The high-case proposed action is not expected to have an impact on these areas. Proposed oil and gas facilities will be located outside the sanctuary boundaries and support bases are located outside the Mid-Atlantic area. Submarine canyons in the Mid-Atlantic Planning Area would be affected by well placement within the canyon. Generally, these areas are of relatively higher productivity than adjacent areas and the fauna would be susceptible to mechanical damage from well placement and the initial mud and cuttings discharge at the sea floor.

CONCLUSION: A moderate impact level is estimated for the high-case proposed action.

#### (i) Impact on marine sanctuaries

There is presently one marine sanctuary, the U.S.S. Monitor Wreck, in the Mid-Atlantic area. One other site is on the Site Evaluation List (SEL), is located at Assateague Island, Virginia, and extends out to Federal waters. Because of the nature and fragility of the Monitor Sanctuary, it would be highly susceptible to mechanical damage. However, its sanctuary status precludes activities in the area. Because of the water depth involved, it is not probable that an oil spill would appreciably impact the sanctuary.

CONCLUSION: The high-case proposed action is likely to have a very low impact on marine sanctuaries in the Mid-Atlantic area.

### (3) Socioeconomic Environment

#### (a) Impacts on employment and demographic conditions

It has been estimated that under the high resource estimate scenario, economically recoverable resources would be approximately 14 times as much as the proposal for the Mid-Atlantic Planning Area. Total employment increases are expected to increase roughly in proportion to increases in resources. However, some economies of scale can be reasonably assumed so as to cause the increase in employment to be somewhat less than the increase in resources. The number of jobs created under the high resource estimate scenario (both direct and secondary) of 2,900 would still represent less than 0.1 percent of the current regional employment level.

A regional peak population increase of 7,500 persons could be associated with the projected employment increase. This represents less than 0.1 percent of the region's population, implying little or no significant stress on the public and private service and facilities of the region as a whole. Impacts are potentially more significant in those counties or independent cities in which direct investments of offshore-related primary activities may be located.

CONCLUSION: Employment increases related to the high resource estimate scenario would have a negligible impact on the size and character of the region's labor force. Impacts at the local level would be minor. Impacts on population are expected to be negligible at the regional level and minor at the local level.

### (b) Impact on coastal land use

Onshore facilities associated OCS exploration and production in the MidAtlantic Planning Area are anticipated to be the same for this high resource estimate scenario as for the proposal's scenario. These scenarios include one new gas pipeline and landfall, a new gas processing and treatment plant, and utilization of an existing support base site at Morehead City, North Carolina. Insofar as possible, these facilities and their potential locations are examined in Section IV.B.2.a(5)(b). It is anticipated that new facilities would be designed and built to accommodate the high resource estimates should such resources be discovered. Impacts on coastal land use are anticipated to be virtually the same for the high resource estimate scenario as for the proposal. No additional onshore facilities are included in the Mid-Atlantic's high resource estimate scenario that have not already been analyzed under the proposed action.

CONCLUSION: Facilities such as the gas pipeline and processing plant are anticipated to have moderate impacts on land use in Mid-Atlantic coastal areas. These and all other facilities which may be proposed are expected to be sited in generally compatible areas. Detailed siting approval and procedural requirements are expected to mitigate those impacts which may occur.

### (c) Impact on commercial fisheries

For a complete discussion of potential impacts, refer to Sections IV.B.2.a(5)(c), IV.B.1.a(5)(c), IV.B.2.a(4)(c), and IV.B.2.e.(2)(c).

The high-case proposed action proposes an additional 108 wells over the meancase estimates. These additional wells could exclude commercial fisheries from a maximum of 22,400 hectares (55,296 acres) of additional fisheries habitat. However, this is only an additional 0.25 percent of the shelf area (between the territorial limit and the 200-m isobath) and assumes that all wells would be located in this area. Generally, the mobility of most commercial species minimizes the impacts from spatial exclusion. Because the assumed number of spills of 1,000 bbl or greater is expected to be the same in both cases, no increase in impact level because of spills is expected.

CONCLUSION: The impact level of commercial fisheries is expected to be low.

### (d) Impact on recreational resources

The types of impacts on coastal recreation and tourism in the affected area of the Mid-Atlantic resulting form visual effects, oil spills, and land use would be the same for the total development scenario as for the proposed action [Alternataive I, see IV.B.2.a.(5)(d) and IV.B.1.a.(5)(d)]. No additional onshore facilities are anticipated for the total development scenario that are not already analyzed under the proposed action. The resource estimates for the total development scenario indicate almost a three-fold increase over the proposed action--mean case in the amount of oil which might be produced in the Mid-Atlantic Planning Area. Additionally, the North and South Atlantic Planning Areas would transport substantially greater amounts of oil through the Mid-Atlantic Planning Area en route to refineries in Delaware Bay (in this total development scenario). Consequently, the relative risk of oil spill occurrence and contact with coastal recreational resources is proportionally increased. Nonetheless, the expected number of spills from all sources for the Mid-Atlantic resulting from total development still does not exceed one (see Table IV.A.4.a.3). Oil spill impacts under this alternative should not exceed those associated with the one spill already assumed to occur as a result of the proposed action--mean case.

CONCLUSION: Impacts upon coastal recreation and tourism in the case of total development are anticipated to be very low. Although certain local areas may experience low or possibly moderate impacts in the unlikely event of oil spill contact, overall impact on the region should remain very low.

### (e) Impact on archaeological resources

The expected number of platforms increases from 1 to 7 in the high case; gas pipelines remain at 1. Some interest has been shown in nearshore grabens. While this interest has been low, activity here could impact archaeological resources. With the majority of interest being in the outer shelf and slope areas, the increase in impact will be slight.

CONCLUSION: Impacts to archaeological resources will increase from very low to low.

### (f) Impact on marine vessel traffic and offshore infrastructure

Generic impacts on marine vessel traffic and offshore infrastructure resulting from OCS oil and gas activities are described in Section IV.B.2.a(5)(h). Traffic Separation Schemes (TSSs) and Precautionary Areas have been established in the Mid-Atlantic Planning Area at the approaches to Narragansett Bay, Buzzards Bay, New York Bay, Delaware Bay, and Chesapeake Bay. Although there are no formal restrictions concerning the placement of structures within TSSs, IMO guidance recommends that lanes remain free of obstructions. The Coast Guard does not usually approve siting structures within traffic lanes or within a 500-m buffer zone on either side of both the inbound and outbound lanes. Alternatively, traffic lanes can be temporarily shifted or suspended to permit exploratory drilling in areas which would otherwise be off limits. However, it is unlikely that exploration activities will take place within the Mid-Atlantic Planning Area TSSs or Precautionary Areas as these areas are of low interest to the oil and gas industry. Seven production platforms are projected for the mid-Atlantic under the high case scenario and 18 supply boats will be servicing these platforms. It is anticipated that all parties concerned with vessel traffic will be able to adjust to the slightly increased level of vessel traffic and to the siting of structures within the planning area.

CONCLUSION: The impact on marine vessel traffic and offshore infrastructure is expected to be very low.

#### (g) Impact on military uses

The proposed action will create conflicts between offshore oil and gas activities and DOD activities in the Mid-Atlantic Planning Area. These conflicts include such matters as offshore operators emissions of electromagnetic signals affecting missile firing events; ship and aircraft traffic interfering with both naval and air training exercises; and the possibility of collision between both submarines and missiles with offshore oil and gas surface or subsurface structures. The specific military operating areas and activities which take place within the planning are are described in Section IV.B.2.a.(2)(b) (Figure III.A.2.a.6-1).

The proposed action will also create a conflict between oil and gas activities and NASA activities associated with the Wallops Island Flight Test Center, Wallops Island, Virginia. The Wallops Island NASA Warning Area delineates the minimum area that NASA feels must be kept free of all surface structures. The portion of the warning area that is included in the proposed action represents only a very small percentage of the planning area.

Any vessel or structure within this area would be subject to the remote possibility of being damaged by falling debris resulting from both successful and unsuccesful rocket and missile launches. If a rig or platform were damaged by debris from a rocket or missile, an accidential release of hydrocarbons could occur if wells and other equipment were not shut in. The shutting in of wells and other equipment during each launch would appear to be impractical because of the frequency of launches (approximately 20 per month).

CONCLUSION: The level of impact on military uses and NASA activities that will occur from the proposed action is expected to be low.

### f. Impacts of Alternative II - Subarea Deferrals

This alternative evaluates the deferral from leasing in this 5-year program of eight additional subareas (14 subareas are already deferred in the planning stages under Alternative I - The Proposed Action.) One of these eight subareas is partially contained in the Mid-Atlantic Planning Area.

Atlantic Coast Nearshore Black Deferral

This subarea consists of a 15 mile buffer zone along the coast of the North, Mid-, and South Atlantic Planning Areas. In the mid-Atlantic, this subarea consists of a shallow marine environment and is generally an area of poorly-sorted, medium-grain-size sand. Many of the valuable commercial fisheries--such as surf clam, ocean quahog, menhaden, and scallops--are found in the area but no determinate, highly-productive biological areas are present. The primary infaunal and epifaunal groups found in the area are annelid worms (polychaetes), mollusks (surf clam, ocean quahog), echinoderms (sand dollars, starfish), and crustaceans (lobsters, crabs).

Several species of marine birds are common in the subarea and many additional species--including one endangered species, the peregrin falcon--migrate seasonally through the subarea. A number of species of marine mammals are found in this subarea, and of the endangered cetaceans reported in the Mid-Atlantic region, the right whale is the most likely to occur in this subarea. Sea turtles are seasonally present in the Mid-Atlantic and two endangered species (leatherback and Atlantic ridley turtles) and one threatened species (loggerhead turtle) are likely to be transients in the subarea. The endangered hawksbill turtle and the threatened green sea turtle also may be present.

Deferral of this subarea would eliminate all potential for onshore visual impacts to the coasts of New Jersey, Delaware, Maryland, and Virginia resulting from offshore drilling facilities. The risk of impacts to coastal recreation areas from platform spills would also be substantially reduced.

Potentially high water quality impacts to local coastlines and embayments resulting from a large oil spill would be reduced to a moderate level.

Deferring this subarea would reduce local impacts to the benthic community and prevent impacts on commercial fisheries resulting from spatial exclusion by drilling rigs or platforms. However, no change in overall impact levels is expected. The potential impacts to endangered or threatened birds, turtles, and cetaceans in the Mid-Atlantic region would remain unchanged if this subarea were deleted. However, local impacts to endangered or threatened species would be removed. If this deletion option were adopted, the probability of an impact on shallow water or coastal areas resulting from a Mid-Atlantic lease sale would be reduced, but no appreciable decrease in regional impact levels would occur.

### g. Alternative III-Add a Sale in the Straits of Florida

The addition of a lease offering in the Straits of Florida will increase the volume of tanker traffic into mid-Atlantic ports. This increase in traffic will cause a corresponding increase in the probability of an oil spill occurring (Table IV.A.4.a.1.and Table IV.A.4.a.4). This increase in probability will not increase the number or oil spills expected. Therefore the impact levels will stay the same for the following categories:

- Physical Environment
  - Water Quality
  - Air Quality
- Biological Environment
  - Intertidal Benthos
  - Subtidal Benthos
  - Fish Resources
  - Marine Mammals
  - Coastal and Marine Birds
  - Endangered and Threatened Species
  - Estuaries and Wetlands
  - Areas of Special Concern
  - Marine Sanctuaries
- Socioeconomic Environment
  - Employment and Demographic Conditions
  - Coastal Land Uses and Water Services
  - Commercial Fisheries
  - Recreational Resources
  - Archaeological Resources
  - Marine Vessel Traffic and Offshore Infrastructure
  - Military Uses

### h. Alternative IV. Biennial Leasing

A biennial leasing program would increase the number of lease offerings in the Mid-Atlantic Planning Area by one more sale to a total of two. The result would be one lease offering in 1988 and one in 1990 (Table IV.B.h-1). The timing of the lease offering in 1988 is different from the proposal in that it has been moved up one year. The lease offering in 1990 is different than the proposal, and has been created by the biennial leasing alternative. Despite the addition of a lease offering the total number of oil spills expected for the Mid-Atlantic is still the same as the proposal because the expected resource levels involved do not increase sufficiently to indicate additional spills (using the standard spill rate). The addition of one lease offerings will increase the number of expectd platforms by one (Table IV.A.1-1, Table IV.A.4.A.1, Table IV.A.1-5, and Table A.4.a.5) locally and planning areawide this would not increase the impact levels over those described for the proposal for the following categories:

- Physical Environment
  - Water Quality
  - Air Quality
- Biological Environment
  - Intertidal Benthos

- Subtidal Benthos
- Fish Resources
- Marine Mammals
- Coastal and Marine Birds
- Endangered and Threatened Species
- Estuaries and Wetlands
- Marine Sanctuaries
- Areas of Special Concern

- Socioeconomic Environment
  - Military Operations
  - Archaeological Resources
  - Marine Vessel Traffic and Offshore Infrastructure
  - Employment and Demographic Conditions
  - Commercial Fisheries
  - Recreational Resources
  - Coastal Land Uses and Water Services

Table IV.B.2.h-1. Schedule of lease offerings for a. The Proposal, and b. Biennial Leasing in Planning Areas other than the Central and Western Gulf of Mexico. (An X indicates that a lease offering has not been numbered.)

Alternative I - The Proposal

| Planning Area | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| North Atlantic | | Sale 96 | | | Sale X |
| Mid-Atlantic | | | Sale X | | |
| South Atlantic | | | Sale 108 | | |

Alternative IV - Biennial leasing in Atlantic OCS Planning Areas

| Planning Area | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| North Atlantic | | Sale 96 | | Sale X | |
| Mid-Atlantic | | Sale X | | Sale X | |
| South Atlantic | | Sale 108 | | Sale X | |

### i. Alternative V-Accelerated Provision

If the acceleration provision is applied to the Mid-Atlantic Planning Area, the result will be one lease offering in 1988. This is different from the proposal only in that the timing of the offering will be moved up by one year, from (1989 to 1988). The number of sales remain the same, namely one. This alternative will not increase the number of expected oil spills or platforms in the Mid-Atlantic (Table IV.A.1-1, Table IV.A.4.a.1, Table IV.A.1-6, and Table IV.A.4.a.6). Therefore the impact levels would not change from those identified for the proposal in the following categories:

- Physical Environment
  - Water Quality
  - Air Quality

- Biological Environment
  - Intertidal Benthos
  - Subtidal Benthos
  - Fish Resources
  - Marine Mammals
  - Coastal and Marine Birds
  - Endangered and Threatened Species

- Estuaries and Wetlands
- Marine Sanctuaries
- Areas of Special Concern

- Socioeconomic Environment
  - Commercial Fisheries
  - Coastal Land Uses and Water Services
  - Recreational Resources
  - Military Operations
  - Marine Vessel Traffic and Offshore Infrastructure
  - Archaeological Resources
  - Employment and Demographic Conditions
  - Refineries

### j. Alternative VI Defer Leasing in Six Planning Areas

The Mid-Atlantic planning area is not one of the six planning areas designated for deferral under this alternative. Therefore, this alternative is not applicable to this planning area.

### k. Alternative VII--No Action

Under the no-action alternative, impacts on the human and natural environment caused by the oil and gas activities of the proposed 5-year leasing program would not occur. Particularly, impacts on water quality, benthic organisms, fish resources, marine mammals, coastal marine birds, and on endangered or threatened species would be avoided. In addition, the expected low levels of impacts on recreational resources, employment (including the positive aspects of employment opportunities in the planning area), and on archaeological resources would not occur; use conflicts between NASA and military operations and oil and gas activities would also be avoided.

The no-action alternative would reduce future potential OCS domestic energy production by 25 million bbl of oil and 419 bcf of natural gas--the mean conditional resource estimates for Alternative I. The reduction of available energy resources could necessitate increased imports of oil and natural gas, require more stringent energy conservation by industry and individuals, and at the same time, dictate the development and utilization of alternative energy sources to replace the energy resources expected to be recovered if the 5-year leasing program were put into effect. A discussion of alternative energy sources is presented in Appendix C.

Alternative energy sources likely to be considered as a result of this noaction alternative would include crude oil and natural gas from non-OCS areas (presumably imports from foreign countries as well as domestically produced oil and natural gas), coal, hydroelectric power, and nuclear power. The most likely combination of energy sources other than OCS-produced oil and natural gas would probably consist of increased imports of oil and natural gas, domestically produced strip-mined coal, and increased conservation of energy resulting from increased prices and capital substitution. Possible impacts or obstacles to implementation of alternative energy sources or actions are discussed in Appendix C and Section II.A.7. Impact factors associated with likely alternative energy sources (Table II.B.7) include such items as increased air pollutant emissions (e.g., SO 2 and particulates), disruption of land, elimination of wildlife habitats, increased water pollution (surface and ground) and waste disposal.

### 3. South Atlantic

#### a. Alternative 1

##### (1) Interrelationship of Proposal with other Projects and Proposals

###### (a) Coastal zone management

Of the affected States for the South Atlantic Planning Area, three (North Carolina, South Carolina, and Florida) have a Federally-approved coastal zone management (CZM) program. All three of these programs identify State policies relating to OCS exploration and development. State CZM programs may restrict the placement of pipelines, refineries, or other support facilities in areas of particular environmental concern and may set standards for their placement elsewhere. However, some provisions for their appropriate location is required by the CZM Act, as amended.

The North Carolina Department of Natural Resources and Community Development is that State's permitting agency for OCS oil and gas activities. The State is generally supportive of offshore exploratory activities and has developed five policies to deal specifically with this issue. These policies advocate an "active role in the OCS decision process" for the State and support a balancing of public environmental, social, and economic interests with the need for an adequate supply of energy. The South Carolina Coastal Council, in administering the South Carolina Coastal Zone Management Program (SCCZMP, 1980), is guided by the Program's "Energy Facility Planning Process" which identified 22 siting policies for energy and energy-related facilities. Related facilities such as support bases or gas plants would be reviewed in the context of these policies, should such development be proposed for a coastal South Carolina location. In Florida's coastal zone management program (FCMP, 1981), the State has pledged their commitment to "develop a workable siting process for nearshore and shoreline (OCS) facilities." Florida's principal concerns involve the impacts of OCS activities on commercial and sport fisheries, the construction of coastal processing and transportation facilities, and oil spill impacts on fishing, recreation, and natural areas. Florida has established policies which are oriented toward facilitating the review process for both OCS exploration plans and any consequential onshore facilities. Onshore energy facility siting in the State will be guided by the provisions of the 1979 Industrial Siting Act (among other laws), which essentially promotes industrial development in appropriate areas.

The Federal Coastal Zone Management Act, in addition to promoting State CZM programs, established the Coastal Energy Impact Program (CEIP). The CEIP includes the following: grants for planning for social, economic, and environmental consequences of expected energy development; financial assistance for new or improved public facilities and services; and grants to ameliorate damage to recreational or other environmental resources when the responsible party cannot be found or charged with damage. Under the CEIP, numerous facility siting studies have been conducted by the States to identify compatible sites for OCS facilities. These studies will aid in the process of assuring that OCS activities do not result in otherwise avoidable conflicts.

For past OCS lease sales in the South Atlantic Planning Area, the Minerals Management Service has analyzed generally foreseeable developments resulting from OCS exploration in relation to the States' coastal management programs. The reader is referred to the Environmental Impact Statements for Lease Sales No. 43, 54, 56, 78, and 90 for this detailed discussion. The section entitled "Impact on Coastal Land Uses" in this EIS provides an overview of the kinds of impacts which may result from the proposed action and its interrelationship with coastal management programs and other land-use plans [Section IV.B.3.a.(5)(b)].

On the whole, it has been determined that a variety of options exist to ensure that OCS development can be accommodated within the context of coastal management efforts. The terms and configuration of the 5-year lease program, as proposed, contain no provisions that would prevent the program from being conducted in a manner which is compatible with the coastal management programs of the South Atlantic States.

### (b) Ocean dumping

Ocean dumping activities in the South Atlantic Planning Area are described in Section III.A.3.a(6)--Ocean Dumping, and dumpsite locations are shown in Figure III.A.3.a.6-1 and in Visual No. 1 (South Atlantic proposed Sale 90 FEIS). Dredged materials are the only materials presently being dumped in the area.

The 13 dredged materials dumpsites (2 off the coast of North Carolina, 4 off South Carolina, 2 off Georgia, and 5 off Florida) are within or close to State territorial waters which extend 3 mi out from shore. Being this close to shore, these dumpsites are highly unlikely to have any interaction in terms of area use conflict or synergistic action of wastes, with the proposed OCS oil and gas activities.

Within the planning area are four major sites formerly used for dumping of undetonated explosives (e.g., bombs and depth charges), one major site formerly used for dumping of chemical munitions (e.g., rocket fuel), and approximately 15 sites for dumping low-level radioactive materials (e.g., contaminated gloves and tools) encased usually in steel drums. Disturbance of these potentially hazardous materials by OCS oil and gas activities (placement of 1 gas pipeline, installation of 1 production platform and drilling of 46 exploration, delineation and production wells) resulting from the 1 sale in the South Atlantic Planning Area is highly unlikely. Under OCS Operating Order NO. 2, MMS has authority to require a lessee to perform pre-drilling hazards surveys. This would include surveys to detect explosives and radioactive materials when such surveys may be warranted. Such precautions would minimize the probability that undetonated explosives or radioactive materials, especially those concentrated within the former dumpsites, would endanger drilling activities or that radioactive materials would be released in the marine environment.

Overall impacts from oil and gas operations on ocean dumping are anticipated to be minor.

## (2) Projects Considered in Cumulative Impact Assessment

### (a) Oil and gas activities (state and federal)

There are currently 20 active leases (Federal leases only) in the South Atlantic Planning Area. The cumulative impact assessment will consider these active leases as well as the proposed and alternative scenarios including the transportation of domestic and imported crude oil and refined products.

### (b) Military operations

The John F. Kennedy Space Center (KSC) at Cape Canaveral in Florida is a NASA installation from which numerous space satellites are launched each year. It is the primary location from which the space shuttle is launched. Shuttle launches are currently taking place approximately 1 every 3 months but are expected to increase in frequency to 18 per year by 1988. The military uses the Eastern Space and Missile Center (ESMC), also located at Cape Canaveral, to test various types of missiles. The area offshore is also used for submarine launch activities. The flight clearance zone for the KSC and the ESMC is the extent of the area which NASA and DOD require to be kept free of surface activity during missile and shuttle launches (Figure III.A.3.a.6-1).

## (3) Physical Environment

### (a) Impact on water quality

#### (i) Offshore

Under normal offshore operations, the primary sources of water quality degradation in the South Atlantic Planning Area would be discharges (from exploratory and/or production rigs) of drilling muds and cuttings, formation waters, domestic and sanitary waste, and deck drainage. Discharge of these routine effluents is regulated by the U.S. Environmental Protection Agency (U.S. EPA) through issuance of National Pollutant Discharge Elimination System (NPDES) permits. Additional routine pollutant sources would be the resuspended bottom sediments (primarily as a result of pipeline burial) and the operational oil discharges from tankers.

Accidental sources of offshore water quality degradation would include the small (usually <50 bbl) chronic oil spills resulting from such operations as fuel transfer or storage. A large (>1,000 bbl) oil spill or release may result from a well blowout, tanker or platform accident, or a pipeline break. Also, accidental gas releases may result from a pipeline break or seam leakage.

These sources (normal and accidental) of offshore water quality degradation are introduced and discussed in general for the Atlantic Region in Section IV.B.1.a.(1)(a)(i) -- (Introduction to Impacts for the Atlantic Region).

The most serious impact on offshore water quality within the South Atlantic Planning Area would likely result from a large (>1,000 bbl), acute oil spill which may occur as a result of a tanker or platform accident, a well blowout, or a major pipeline break. For the proposed action, which includes 1 sale, it is assumed that only 1 oil spill of greater than 1,000 bbl would occur within the planning area (Table IV.A.4.a.1). A high level of water quality impact may be expected if such a large oil spill occurred close to shore or was transported there by winds and currents, such that the oil was then tied-up within a low energy regime having poor circulation as in an embayment. This may result in elevated levels of oil and weathered products being retained and reintroduced within the shallow water column for extensive periods of time. However, most of the South Atlantic Planning Area is of an open ocean type with good circulation (dominated by the northeastward flowing Gulf Stream) such that the 1 large assumed oil spill would likely be quickly degraded and its effects would be temporary, thus resulting in a low overall water quality impact.

Local water currents and depths would greatly influence the fate of the estimated 666,000 bbl of drilling muds and 206,000 bbl of drill cuttings which would be discharged by the proposed action. Generally, however, because of the relatively small volume of the drilling discharges compared to the large volume of receiving water, the predominantly rapid settling and dispersion of the discharged materials to background levels, and because discharges would be spaced over a large area and long period of time (approximately 9 years), impacts on ambient water quality are expected to be low. Also, only those muds designated by the U.S. EPA to be environmentally acceptable, as determined by bioassay test results, can be discharged on the OCS. The anticipated low impact on water quality from drilling muds and cuttings by the proposed action is in agreement with the general conclusion of minimal environmental risk determined by the National Research Council Marine Board study (NRC-MB, 1983).

Discharged formation waters (55.2 million bbl), which would be released over an approximate 25-year period, would be diluted rapidly and ultimately lost in the large volume of receiving water. Depending on hydrographic conditions, background levels of trace metals would be reached within a few hundred meters. The hydrocarbon content of discharged formation waters would be within the U.S. EPA's prescribed effluent limits [the concentration of oil should not exceed an average 30-day concentration of 40 mg/l (40 CFR 435)].

Minimal impacts are expected from the discharge of domestic wastes, sanitary wastes, and discharge of low levels of oil from such sources as deck drainage. These discharges are regulated by the U.S. EPA through the National Pollutant Discharge Elimination System (NPDES) permit requirements and are quickly diluted to ambient levels in the receiving waters.

An increase in levels of suspended sediments and turbidity as a result of gas pipeline burial or breakage would be a local and temporary phenomenon.

Operational discharges of oil from ships would not substantially affect water quality in that only a limited increase in shipping by oil tanker is associated with the proposed action. Also, recent stricter regulations now address discharges from vessels (e.g., discharges are permitted only 50 mi beyond land.)

CONCLUSION: A low, overall impact on water quality is anticipated from the proposed action (see Appendix A for impact level definitions). Discharge of routine effluents such as drill muds and cuttings and formation waters and the action of gas pipeline burial or breakage would result in generally localized and relatively minor water quality perturbations. Although a large accidental oil spill could cause a severe alteration of ambient water quality, this is likely to be only temporary.

CUMULATIVE IMPACTS: When all oil spill sources are considered, the total expected number of large (> 1,000 bbl) oil spills within the South Atlantic Planning area over a 30-year period is calculated to be 3.41 or, for impact analysis purposes, assumed to be 4 oil spills (Table IV.A.4.a.2). The sources of these oil spills include OCS oil and gas activities (including the proposed action), tanker transport of imported (foreign) oil, and domestic tanker transport--all of these sources having roughly equal importance in terms of oil spill risk (Table IV.A.4.a.2.). As the occurrence of a large spill increases, so does the possibility that some spilled oil may be carried westerly along with ocean filaments. This may result in the intrusion of offshore Gulf Stream water and associated oil into shallower coastal areas where potential impacts on water quality are generally increased.

Under a cumulative case consideration, the total OCS oil and gas exploration and production activities within the planning area would result in a substantial increase in the volume of routine discharges (drilling muds and cuttings, formation waters, domestic and sanitary wastes, and deck drainage). Compared to the proposed action alone, this increase may be as much as 12-fold for some of these discharges. However, the total volume of these materials would still be small compared to the large volume of the receiving water. These materials would be rapidly dispersed/diluted within a geographically large area and spaced over a long (possibly 30-year) period such that the impacts to water quality, from these discharges, would be low and temporary in nature.

Operational oil discharges from tank ships constitute a large oil input into east coast waters (estimated at 4.3 million gallons for the Atlantic area 3 to 400 mi off the U.S. east coast) (NOAA, 1984--preliminary result). However, the greatest concentration of dispersed and weathered oil from operational discharges expected to be found off the east coast (3 to 200 mi offshore) is only slightly greater than 0.1 gallons per sq mi (NOAA, 1984--preliminary results). Thus,the overall impact to water quality from these discharges seems low.

Thirteen active, coastal dredged-materials dumpsites are located within the South Atlantic Planning Area [discussed in Section III.A.3.a(6)--Ocean Dumping]. The impact on water qualiy from these U.S. EPA approved dumpsites is uncertain since most of these sites have "interim" status meaning that environmental studies for determining impact have not been completed.

CONCLUSION: A moderate impact on water quality is anticipated when the cumulative effects of all actions are considered. As the assumed number of large oil spills within the planning area is increased from 1 (proposed action alone) to 4, so does the likelihood of a substantial alteration of ambient water qulity.

### (ii) Onshore

Onshore water quality degradation will occur as a result of increased non-point and point sources of pollution associated with the construction and operation of onshore facilities supporting the South Alantic Planning Area OCS activities.

Runoff from construction and operation of onshore support facilities constitutes a non-point pollution source. The construction of 1 new gas pipeline (and associated landfall) and 1 new gas processing plant will lkely cause increases in surface runoff to nearby streams and rivers. This runoff would likely contain increased levels of suspended solids and heavy metals. Non-point source impacts may be minimized by controlling erosional effects generated within constuction site boundaries, with several of the adverse impacts being localized and prevented from having offsite impacts on water bodies in the vicinity of these activities. Increases beyond normal background levels would be temporary and of a limited duraton.

Increased effluent discharges will occur through point sources related to oil and gas operational support activities, primarily the 1 new gas processing facility. Wastewater discharge from a plant would include chemicals such as chromate, zinc, chlorine, phosphate, sulfide, and sludge conditioners, as well as oil and grease. Four sources of wastewater from operation of the new support base would include sewage, bilge water, ballast water, and cooling water (NERBC, 1976). Point source discharges, however, will be subject to Federal and State water pollution control regulations and permitting; thus, potential adverse impacts can be mitigated.

CONCLUSION: The overall impacts to onshore water quality are anticipated to be low.

CUMULATIVE IMPACTS: Sources which may cause degradation of onshore water quality in the South Atlantic Planning Area, in addition to those associated with the proposed action, are diverse and numerous. These sources can be broadly categorized as intentional point (or pipeline) discharges, non-point discharges, and accidental discharges. The following discussion of these sources which may cumulatively affect onshore and nearshore water quality has been taken from NOAA's National Marine Pollution Program Plan (NOAA, 1981).

The major intentional point source discharges of waste materials into inshore and coastal areas come from sewage treatment facilities, industrial facilities, and electric-generating facilities. These pipeline discharges are regulated by the U.S. EPA through the National Pollutant Discharge Elimination System (NPDES). In 1979, more than 5,000 NPDES permits were held for ocean outfalls in coastal counties. The effluent from the industrial and sewage treatment facilities may contain, even after treatment, substantial quantities of synthetic organics, heavy metals, suspended solids, oxygen-consuming materials, and nutrients; sewage effluents may also contain fecal coliforms and potentially pathogenic microorganisms. Power plant cooling water discharges may be elevated in temperature and have increased chlorine levels.

Non-point source pollution occurs when runoff enters a body of water carrying with it pollutants from the land, such as petroleum hydrocarbons and lead from parking lots, pesticides and nutrients from residential lawns or agricultural fields, pathogens from faulty septic systems, or toxic materials from industrial areas (e.g., copper from a dry-dock hull-sanding area). In many areas the pollution from non-point sources is increased by the presence of coastal facilities and, in most regions, non-point source pollution accounts for a major portion of the contaminants that enter coastal waters. In contrast to the significant progress made during the 1970s in controlling industrial treatment facilities, progress with non-point sources is negligible (CEQ, 1980).

The accidental discharge of oil and hazardous materials into water bodies may occur during loading and unloading operations in ports and harbors, pipeline leakage, equipment failures, and spills from land vehicles and storage facilities onshore. The operation of some coastal facilities can result in large accidental spills or chronic unintentional discharges into coastal waters. For example, it has been estimated by Richardson et al. (1985) that, on the average, each fueling of a pleasure craft at a marina results in the spillage of a fluid ounce of gasoline or diesel fuel (NOAA, 1981).

In general, the onshore and nearshore water degradation in the South Atlantic Planning Area is associated with areas of heavy urban and industrial development. The proposed action represents one of many onshore impact-producing agents in the South Atlantic Planning Area and as such represents a very small portion of the cumulative impacts on water quality.

CONCLUSION: The cumulative impacts on water quality, including effects from actions not related to the proposed action, are anticipated to be moderate overall; localized high impacts may occur in the more heavily urbanized and industrialized coastal areas.

### (b) Impact on air quality

The types of air pollutants and allowable emission levels expected from OCS activities in the south Atlantic would be the same as those described for the north Atlantic [see Section IV.B.1.a.(3)(b)] because the same types of activities and facilities are anticipated. A higher level of emissions can be expected commensurate with the higher resource estimates. However, OCS activities resulting from the proposed action should have a very low impact on onshore air quality because of the low number of antici-pated wells and production platforms and limited activities associated with the oil and gas resource estimates. Nearshore OCS activities should not exceed the National Ambient Air Quality Standards because of DOI emission requirements and prevailing offshore winds. Potential problems could result if OCS operations occur in proximity to the Swan Quarter National Wilderness area in North Carolina (a Class I area). If the OCS activities were projected to have a significant effect on any Class I area, mitigation or termination of the polluting activities would be required under the existing regulations. The development scenario for this action assumes that natural gas would be transported via pipeline to an onshore gas processing and treatment facility in a presently undetermined location. Such a facility would be individually designed for the particular gas stream that it processes. The type and magnitude of air emissions are determined by the volume of gas processed, the composition of the gas stream, plant design, and choice of pollution control equipment. If the gas stream contains a high concentration of hydrogen sulfide, H2S (i.e. "sour gas"), the "sweetening" process will result in large amounts of SO2 emissions. SO2 emissions resulting from the procesing of "sweet gas" (low H2S content) are normally not a problem. Other potential pollutants from gas plants include nitrogen oxides, particulates, carbon monoxide and other hydrocarbon gases. A typical gas plant's emissions may include

| | (tons/year) |
|---|---|
| NOx | 1,590 |
| SOx | 221 |
| CO | 56 |
| particulates | 36 |
| hydrocarbons | 24 |

CONCLUSION: Proposed OCS activities in the South Atlantic Planning Area should have a very low impact on onshore air quality in the region.

CUMULATIVE IMPACTS: Resource estimates in the cumulative case for the South Atlantic Planning Area reflect more than a 12-fold increase over the base case. Commensurate increases can be expected in OCS activities and resultant pollutant emissions. However, OCS facilities and activities would still be required to adhere to the DOI air quality regulations, and, when applicable, the State Implementation Plans (SIPs) promulgated under the Clean Air Act Amendments of 1977. Non-OCS-related activities such as increasing industrial activities, automobile emissions, and urbanization may also contribute to air pollution problems over the next 20 to 30 years. A variety of measures such as the SIPs mentioned above and automobile inspection and maintenance programs should aid in controlling these emission sources. Recent trends on a national basis have indicated a fairly steady decline in major pollutants such as SO2, CO, NO2, and particulates. This decline has not been conclusively demonstrated for ozone which may remain as a pervasive pollution problem for the forseeable future. Available data indicate that the affected states of the South Atlantic Planning Area reflect trends essentially the same as those found on a national scale.

In summary, although an increase in air pollutant loads might occur in the cumulative case, various measures currently in place on the state and national level, combined with other controls such as DOI's air quality regulations for OCS activities should be effective in limiting or even reducing the overall adverse impacts upon air quality in the region.

CONCLUSION: Cumulative activities should not exceed a moderate level of impact on onshore air quality.

### (4) Biological Environmental

#### (a) Impact on plankton

Although under the proposed action there will be an estimated 46 wells discharging 666,000 bbl of drill muds and 206,600 bbl of cuttings it is not expected that noticeable impacts on plankton from drilling discharges will occur. The impacts from drilling discharges are very localized and will not affect an appreciable area in the South Atlantic Planning Area. Impacts on plankton from platform and pipeline placement would be short-term, one time occurrences with impacts moderated by water depth and the large size of the receiving waters area (approximately 174,000 sq. mi). An assumed oil spill of 1000 bbl or greater occurring once with a 25 year activity period would also have a negligible regional effect on plankton. Generally plankton sustain short-term impacts and quickly compensate.

Overall, with regard to the size of the area and the spatial and temporal separation of the events, a low impact level could be expected.

CONCLUSION: Plankton would experience low level impacts under the proposed action.

CUMULATIVE IMPACTS: Under the cumulative case, plankton of the south Atlantic will be subject to 9,792,000 bbl of drill muds and 3,049,700 bbl of cuttings. The increase in spills from 1 to 5 indicates also that a much larger area could be affected. The impact to some members of the plankton community (primarily meroplankton) would be moderate if a spill occurred spacially and temporally concurrent with larval recruitment to the plankton community. For all scenarios, the phytoplankton component will only sustain short-term, localized impacts and will quickly compensate.

CONCLUSION: Plankton are expected to experience a low cumulative impact.

#### (b) Impact on benthos

##### (i) Intertidal

The intertidal zone of the south Atlantic area is a fine sand barrier beach island system. It is considered to be a low energy environment, influenced by long shore transport. The area is subject to seasonal storm events which periodically modify the beach. Beach morphodynamics are such that a seasonal depositional and erosional cycle can be seen. Generally, the area is considered to be moderately populated with benthos.

The only OCS operational activity likely to occur is the trenching in of a gas pipeline. The periodic erosional and depositional nature indicates impacts would be short-term. The size of the area in the proposed action is large with most portions located at a distance from the intertidal zone.

The probability of oil reaching the intertidal area is low because of microbial degradation, evaporation, and dispersion by wave and current actions. Any impacts incurred, should oil reach the area, would most likely be dissipated in 1 year. Since the probability of an oil spill is low, impacts can be expected to be of a very low level.

CONCLUSION: Impacts on the intertidal benthos are expected to be low.

CUMULATIVE IMPACTS: In the cumulative case, of the OCS activities only the placing of the pipeline under the proposed action is expected to impact intertidal benthos. This is a one-time only operation causing a high but short-term local impact. Previous leases and proposed leases will not have any drilling activity closer to shore than a minimum of 3 miles. This distance severely limits possible impacts from discharges occurring in intertidal benthos.

The number of assumed oil spills will increase by 4. However, this increase is attributed primarily to the increase in transportation of imported foreign oil. If an oil spill were to reach the intertidal area, impacts could be expected to be high locally and short-term.

Non-related oil and gas exploration activities such as trawling and dredging dumpsites are not expected to impact the intertidal zone. Both activities occur offshore where sediment disturbances occur naturally and benthic communities re-establish readily.

CONCLUSION: Cumulative impacts are expected to be low on intertidal benthos. This represents a negligible change as a result of the proposed action.

### (ii) Subtidal

The benthos in the South Atlantic Planning Area will be subject to mechanical perturbation, drilling discharges and oil spills.

Mechanical perturbation, by definition, is a localized effect proximate to drill sites or pipeline corridors. Though approximately 800 miles would be placed, a regional perspective would define the impacts as minor, since relatively little area is involved and effects on regional populations or communities would not be evident or persistent. A local perspective, however, would require a classification of major impact--which means that populations or communities of limited spatial extent (e.g., calico scallop beds, royal shrimp grounds, and moderate and high relief live-bottom areas) would be more susceptible to severe impacts than cosmopolitan species or assemblages. Mechanical disturbance of communities which take an extended period of time to form their physical structure and faunal integrity (e.g., moderate and high relief live-bottom areas) would be classified as having a high impact, since the effects would persist longer than one recruitment period. The impact on soft substrate areas in which the pipeline will be buried would be moderate. The impact on soft substrate areas proximate to exposed pipeline would be low, and it is possible that these areas may be biologically enhanced since the pipeline would provide a hard substrate for attached organisms.

The potential impacts resulting from the release of muds and cuttings into the environment include the following: 1) increased turbidity causing decreased primary production because of reduced light levels; 2) increased particulate levels causing interference with or damage to filter-feeding apparatus; 3) burial of benthic communities; and 4) acute or chronic effects of the constituents of the drilling muds and produced waters. Since the magnitudes of the potential impacts are directly related to the concentrations of the muds and cuttings, factors which will increase dispersion are important counteracting determinants. The most important of these would be the magnitude and direction of currents through the water column and water depth.

Since the degree of impact on benthos is directly related to the amount of muds and cuttings (e.g., burial, modifying sediment structure, clogging gills and feeding apparatus), discharges in shallow water with lower current velocities will result in greater impacts. Discharges from drill sites on the Florida-Hatteras slope and shelf, north of Cape Canaveral, in water depths of less than 200 m, will have a moderate impact on the surrounding benthos in soft sand areas. The cuttings would form low mounds within the immediate area since fractionation of the muds and cuttings would be minimal in the low current velocities and shallow water depth. Re-sorting by bottom currents, tidal currents, storm events, and bioturbation subsequently would mitigate the impacts, and recolonization would proceed. In moderate and high relief live-bottom areas the impact of cutting discharges would be major because burial would destroy the organisms comprising the structure of the live bottom. This impact would persist after any mitigation by re-sorting forces.

In water depths greater than 200 m, within the planning area, the Gulf Stream is the predominant surface and mid-water current. Fractionation of the muds and cuttings would be appreciable because of the high current velocities and increased water depth.

Stetson _et_ _al_. (1962) have described living deepwater coral reefs on the Blake Plateau. Little is known about the specific locations of individual areas of living coral and not all corals are associated with coral banks. Many living corals have been recovered from the northern end of the Blake Plateau attached to large phosphorite gravels and pavements. The inner Blake Plateau is severely scoured by Gulf Stream currents (Pinet _et_ _al_., 1981). This strong current and depth of water would prohibit the accumulation of any drill muds or cuttings which could have an impact on the benthos. Impacts, therefore, would be low in this area.

Additives to drill muds were considered possible toxicants. Battelle

(1983) conducted an intensive, two-tiered infaunal sampling program around the Georges Bank exploratory drilling area. No statistical correlation between barium concentration (an indicator of drilling solids accumulation) and faunal composition was found.

Thompson and Bright (1977) applied barite Aqualgel (bentonite clay) to small colonies of three reef corals, Diploria strigosa, Montastrea cavernosa, and Montastrea annularis. The corals were able to clear their surface of the sedimented material rapidly. Thompson and Bright (1980) studied the effect of exposure to a used, whole drilling fluid on polyp behavior among a group of seven corals. This study indicated that sublethal behavioral effects were elicited in most species of coral exposed to a light-density lignosulfonate fluid at 100 to 316 ppm.

The most toxic drilling fluid evaluated to date has a 42-day, LC50 value for opossum shrimp of 50 ppm of whole mud. It is estimated that dilution ratios of 100:1 for most drilling fluids and 20,000:1 for the most toxic drilling fluid evaluated would reduce the concentrations in the receiving water below acutely toxic levels.

Studies of the acute lethal effects to drilling fluids exposure have tested the reactions of 48 species including representatives of 11 groups: plankton, copepods, isopods, amphipods, gastropods, decapods, bivalves, echinoderms, mysids, polychaetes, and finfish. The conclusion drawn from these data is that, for the fluids and species tested, the potential acute lethal toxicity of drilling fluids is generally very low.

Formation waters may contain up to 350 ppt of dissolved solids, are low in dissolved oxygen (usually anoxic), have elevated temperatures (30-40°C), and contain 25 ppm of hydrocarbons (EPA, 1976; Galloway, 1981). In the south Atlantic area, current velocities are usually greater than 25 cm/sec, therefore, dilution to low concentration will occur very quickly.

Numerous mortalities of benthic invertebrates have resulted from oil spills which have contacted the bottom community. The predominant cause of death is smothering. However, if the spill is recent (<3 days), little weathering may occur and the presence of the lighter, more toxic aromatic fraction may be a contributing factor to the mortalities.

The Arndt-Schult effect indicates that some organisms have the ability to compensate for minor toxic stress and in some cases overcompensate. This results in an enhanced physiological response to low level toxicant doses. It is likely that many marine organisms have compensatory physiologies which would enable them to tolerate low concentration-low duration hydrocarbon inputs, but long-term exposure is probably more environmentally hazardous.

The direct impact to the benthos from oil spills will be greater in shallower water (<60 m) and in the intertidal zone. However, the extent of the impact is dependent upon the total amount of area contacted, time of year, physical regime of the area, kind of petroleum product, and type of biological system involved. The associated impact to the benthos could range from none to high depending upon the relative degree or status of the previous variables. An oil spill which is coincident with the spawning season could have a major impact.

Under the proposed action, the impact from mechanical damage to benthic organisms in soft substrates would be localized and very low. In low relief live-bottom areas mechanical impacts would be low. On moderate relief and high relief live bottoms, impacts from mechanical damage would be high. Some reduction or modification in local benthic populations may result from the discharge of drill muds and cuttings. The overall impact resulting from mechanical damage to the regional benthic environment would be low. Impacts to deepwater benthic environments resulting from the one oil spill would be very low. There is a possibility of moderate impacts from an oil spill which enters shallower water or strikes land.

CONCLUSION: On a regional basis, moderate impacts to the subtidal benthos are expected to result from the proposed action.

CUMULATIVE IMPACTS: The proposed action, existing leases, and transportion of petroleum through the planning area could have unavoidable impacts on the benthic environment resulting from oil spills and discharges of drill muds and cuttings. The impacts caused by drill muds and cuttings estimated to be discharged from cumulative operations will be highly variable, depending on the location of operations. The inherent mitigating variables of current velocity and water depth determine the degree of accumulation of drilling muds and discharges. Because of the low toxicity and quick dilution of drill muds and cuttings, and the sediment re-sorting forces in the region, impacts are expected to persist less than one seasonal cycle and be localized and low. However, if the discharges acutely degrade the structural integrity of biological areas of limited areal extent (e.g., moderate and high relief live bottoms), the impact would be moderate to high.

For the cumulative case, over the next 30 years it is predicted that, taking into consideration all sources, several oil spills greater than 1,000 bbl could occur. The majority are expected to result from the transportation by tanker of imported foreign oil through the planning area. However, because the spills are predicted to occur over a long period of time, and because of the surface current regime of the area, the majority will probably decay at sea in deep water. Impacts resulting from dredge spoil disposal in the nearshore environment are very low. Trawling in shallow water could redistribute sediments, but the impacts which result would be very low and not distinguishable from natural re-sorting forces in the region.

CONCLUSION: In the cumulative case, a moderate impact to the subtidal benthos would result.

### (c) Impact on fish resources

The shelf habitat in the south Atlantic varies from the north and mid-Atlantic in that the shelf break, and therefore the entire shelf, is relatively shallow at depths of 90-110 m. In addition, the shelf habitat is unique from the other planning areas because of the numerous live-bottom areas which are highly productive biological systems. Destruction of these habitats by the placement of structures such as platforms and pipelines would cause moderate local impacts to fish resources. However, the potential area which may sustain mechanical impacts, even if all production assumptions are realized, is small compared to the extent of the planning area or spatial distribution of the fishes in general. The potential for very high impacts to occur as a result of mechanical damage, however, is present for two commercial species: the calico scallop (*Argopecten gibbus*) and the royal red shrimp (*Hymenopenaeus robustus*). The very high impact potential is a result of their limited primary distribution and known habitat. However, before platform or pipeline siting is finalized, surveys which would detect these habitats are anticipated. Realignment could then occur to minimize impacts.

Impacts from the discharge of drill muds and cuttings, formation waters, and incidental hydrocarbons are projected to be minor. In reviewing the effects of drilling discharges on marine biota, the National Academy of Sciences (1983) concluded that existing information on the fates and effects of drilling fluids and cuttings on the OCS demonstrated that the effects of individual discharges are quite limited in extent and are confined mainly to the benthic environment. This suggests that the environmental risks of exploratory drilling discharges to most OCS communities are small.

The dispersion capabilities of most receiving waters reduce concentrations of drill muds rendering them relatively nontoxic within short distances (Gallaway, 1981). Ayers *et al*. (1980) found that suspended solids and trace metals concentrations in a 275 bbl/hr test were at background levels approximately 500 m from the discharge source and reached the same levels in approximately 1,000 m from a 1,000 bbl/hr test. The planning area can be characterized as primarily deep water and largely under the influence of the swiftly moving Gulf Stream. Given these rapid dispersion characteristics and deepwater nature of the majority of the planning area, minimal impacts from drilling fluid discharges are expected to result from the proposed action. The shallower shelf area would be more susceptible to the discharge of drill muds and cuttings, particularly in the live-bottom areas. Direct discharge in the vicinity of these habitats may destroy or debilitate the epifaunal and epifloral organisms which are constituent parts of these three-dimensional systems and a primary factor for their productivity as fishery habitats.

Oil, which can have lethal or sublethal effects, has a wide range of impact intensities dependent upon the species affected, time of year of the spill, chemical composition of the oil, amount spilled, previous exposure, and the physical oceanographic characteristics of the receiving water. An oil spill which may occur from the proposed action has the potential to adversely affect fish resources. This is particularly true for resources that occupy restricted habitats and are not migratory or highly mobile. Fish resources in the south Atlantic that fall into this category include calico scallop, royal red shrimp, and many outer-shelf and shelf-edge live-bottom species.

The magnitude of impact from a spill is highly variable. Assessment of impact on a biological resource is most often based upon long-term effects to the population as a result of initial egg and larvae mortalities. Egg and larvae mortalities are critical because these early life stages are often planktonic and, therefore, unable to avoid spills. In addition, toxicity thresholds are usually lower during these life stages. Adults are not immune to the effects of an oil spill but exhibit greater toxic resistance and responses other than direct mortality. Such responses to oil spills often include avoidance behavior or sublethal effects, which are difficult to evaluate. However, benthic organisms, such as shellfish, obviously cannot avoid oiled waters, and demersal biota, such as blue crabs, may not necessarily avoid oiled sediments (Olla _et_ _al_., 1980). For any south Atlantic species, eggs and larvae are subject to ecological conditions which are extremely variable from year to year. This results in fluctuating annual recruitment for most south Atlantic fish resources. Those species which rely heavily on one or a few successful year classes to supply the majority of the recruitment to the adult population are particularly vulnerable to environmental perturbations, both natural and man-induced.

CONCLUSION: Because of the minimal effect that drilling discharges and structure placement would have on planning-area-wide fish resources, and because the potential risk from an oil spill as a result of the proposed action is very low, a low impact level is expected.

CUMULATIVE IMPACTS: Cumulative impacts on south Atlantic fin-fish and shellfish species can be evaluated by projecting impacts associated with the proposed action, existing leases, and tanker transport of foreign oil (both refined and crude). In addition to these factors, cumulative impacts on commercial and sport fishery resources are produced by fishing pressure and exposure to environmentally hazardous conditions in other areas contacted during extensive north-south migrations demonstrated by some south Atlantic fish resources.

Fish resources of the south Atlantic are projected to be affected to a low degree from the proposed action alone. This impact level would mean factions of the regional populations would show changes in abundance and/or distribution, but the regional population, as a whole would not be adversely affected. Most stocks in the south Atlantic are not existing at a precarious population level as are the tilefish and striped bass stocks of the mid-Atlantic.

Some south Atlantic fish resources such as sharks, billfish, tuna, and bluefish are migratory, and may be exposed to degraded environmental conditions during their migrations. Little is known of the effects of these other areas on migratory species. It is not anticipated that the proposed action represents the additional stress factor required to produce long-term population reductions.

CONCLUSION: Cumulative impacts on south Atlantic fish resources, are expected to be moderate.

### (d) Impact on marine mammals

The marine mammal species that occur in the planning area could be disturbed by drilling activities and support vessel traffic and therefore, could be displaced from feeding and breeding grounds. A specie of marine mammal endemic to the south Atlantic is the bottlenose dolphin. Bottlenose dolphins feed primarily on fish and can be located over a wide area of varying depths. Nearshore vessel traffic could heighten the risk of collisions with bottlenose dolphins. Seismic testing could also affect animal activity and behavior patterns. However, the relatively low level of OCS operations anticipated should not result in any lethal impacts to these animals. From what is known about cetacean behavior and physiology, it is unlikely that an oil spill would have a lethal effect on any individuals or stocks.

CONCLUSION: A low level of impact on marine mammals in the South Atlantic Planning Area is anticipated to result from OCS activities associated with the proposed action.

CUMULATIVE IMPACTS: Existing leases and transportation of imported foreign oil will contribute to the increased number of oil spills (+4) anticipated in the south Atlantic over the next 30 years. Because none of the existing leases are closer than 50 miles to shore and the Gulf Stream has a northbound flow, the probability of any spills or discharges reaching shore in quantity is low. Spills out at sea will have little impact on mammals; dolphins have displayed an oil detection and avoidance ability, also, any spill occurring at sea will most probably degrade and disperse before it can reach shore.

An increase in support vessel traffic and transportation of oil to the mid-Atlantic will raise the probability of marine mammals being struck by vessels. Other activities such as dredge dumping are not expected to affect either manatees or bottlenose dolphins. Manatees could suffer because of land development near areas where they live and feed, through increased recreational boat activity and vegetation reduction.

CONCLUSION: The cumulative impacts from the proposed action, existing OCS leases in the South Atlantic Planning Area, and from other activities could pose a low threat to marine mammals in the south Atlantic.

### (e) Impact on coastal and marine birds

OCS drilling-related activities in the South Atlantic Planning Area could displace seabirds from feeding grounds or disrupt activity and behavioral patterns during migratory, resting, or feeding periods. For most species of seabirds in the region, breeding and nesting activities do not occur in the south Atlantic area. Coastal marshes and wetlands in the south Atlantic support large numbers of wading birds and migratory shorebirds. Under the proposed action there will be the development of a gas processing plant. The location and development of this site could affect coastal bird species and their habitats. It is assumed that 1 oil spill could result from the 1 proposed sale. If seabirds come in contact with this spill, mortalities will occur. Bird populations could be stressed by being forced to vacate preferred feeding or resting grounds. Prey availability could also be affected by a spill. However, because of the size of the planning area, the daily and seasonal movements of the birds, and the low number of assumed spills, the assumed spill should not pose a serious threat to seabird populations inhabiting the south Atlantic area.

CONCLUSION: OCS activities assumed to result from the proposed action in the South Atlantic Planning Area could have a low level of impact on seabird populations.

CUMULATIVE IMPACTS: Under the cumulative case no additional support bases, pipeline landfalls, or onshore facilities are expected to be needed to develop the cumulative oil and gas resources. Therefore, the cumulative effect of OCS development activities in the south Atlantic region would be negligible compared to what is projected for the proposed action.

Because crude oil recovered from the South Atlantic Planning Area is expected to be transported to refineries in the Mid-Atlantic Planning Area, OCS development in the south Atlantic could have a cumulative effect on birds and their habitats occurring in the mid-Atlantic area. A tanker carrying crude oil from the south Atlantic could spill oil on marine and coastal birds, shorebirds, and waterfowl particularly in the Chesapeake and Delaware Bays or along the Delaware, Maryland, and Virginia coasts. In addition, because many seabirds migrate, they may be exposed to impacts occurring in adjacent OCS regions. Therefore, when OCS development in both the south and mid-Atlantic are considered, the potential for and the degree of impact on seabirds and their habitats increases.

Impacts that are not related to OCS activities but could contribute to a cumulative impact on avian resources include the loss of nearshore and onshore feeding and breeding habitats from private and recreational development which will pose a serious threat to wading birds and shorebirds in particular. Those species which migrate as far as Central and South America could be exposed to toxic substances which are widely used, like DDT, that will inhibit reproduction. Chemical wastes from designated ocean dumpsites could have an adverse effect, especially on marine birds, by degrading the ocean environment. Marine birds will also be exposed to oil spills from oil imported into the South Atlantic Planning Area.

CONCLUSION: The cumulative impacts from proposed and existing OCS leases in the south Atlantic region combined with non-OCS activities could have a moderate level of impact on avian resources inhabiting the region.

### (f) Impact on Endangered and Threatened Species

The types of OCS-related impacts identified in Section IV.B.1.a(4)(f) could also occur and affect endangered or threatened birds, sea turtles, and marine mammals inhabiting the south Atlantic. The South Atlantic Planning Area is important to migrating peregrine falcons, nesting bald eagles, and wood stork rookeries. OCS activities associated with the proposed schedule could affect endangered or threatened birds because an additional onshore support facility is expected to be constructed. There is a low probability that the endangered species will come in contact with the 1 assumed spill.

The south Atlantic is an important summer feeding ground for endangered or threatened sea turtles, especially the green turtle. OCS activities could disrupt or displace feeding sea turtles. In their latest Biological Opinion (July, 1984, Consultation for Lease Sale 90, South Atlantic area), the National Marine Fisheries Service (NMFS) determined that proposed OCS exploration activities were not likely to jeopardize populations of endangered or threatened sea turtles. The 1 assumed oil spill, though, could directly affect prey species or inhibit or prevent feeding activities. However, only a low level of OCS drilling activity is expected to result from the proposed schedule. Therefore, it would be unlikely that any turtles would be seriously inhibited from feeding or permanently excluded from prime feeding grounds. The south Atlantic coast is the principal U.S. nesting area for loggerhead, green, and leatherback sea turtles. An oil spill fouling a nesting beach could discourage nesting activity or reduce the success rate of individual nests. The probability of an oil spill reaching a nesting beach would be high for nearshore spills but lower for spills beyond the Florida-Hatteras shelf (the majority of the planning area). Oil spills reaching nesting beaches during non-nesting periods have not been found to have an adverse effect on the use of these beaches. The risk of turtles at sea contacting the 1 assumed spill would be low because of the size of the planning area and the seasonal movements of turtles through the area.

Seven species of endangered marine mammals inhabit the South Atlantic Planning Area. The humpback whale occurs in the south Atlantic primarily during spring and fall migration periods. Fin, blue, and sei whales generally prefer more northern waters beyond the planning area. Sperm whales can be encountered year-round in the region. The right whale migrates out of the area in the spring and returns in the fall. The south Atlantic region is also believed to be the winter calving ground of the right whale. The manatee occurs primarily in the coastal and inland waterways of Georgia and Florida. The low level of OCS drilling activity and support vessel traffic resulting from the 1 proposed sale should not seriously interfere with the breeding, feeding, or migrating behavior of most whales, however, an exception would be the right whale. The NMFS has determined, in accordance with the Endangered Species Act, that for the south Atlantic region (consultation for Lease Sale 90), populations of humpback, fin, blue, sei and sperm whales would not be jeopardized by proposed OCS activities. However, OCS activities conducted during the right whale calving period could jeopardize the continued existence of the species unless mitigating measures are developed by MMS. The 1 assumed oil spill is not expected to seriously affect any whale species, except for the right whale. An oil spill could disrupt calving activities or harm the newborn calves. This could be significant because of the severely depleted status of the population. The manatee would suffer if an oil spill reached the shallow coastal waterways used by the species. Manatees may not be able to avoid an oil spill that enters coastal waters. Sick animals and juveniles could experience more serious effects from an oil spill.

CONCLUSION: Most endangered and threatened species could experience a low level impact, except the right whale which could experience a high level of impact.

CUMULATIVE IMPACTS: Under the cumulative case the South Atlantic Planning Area will have an increase of 591 wells. The development and production of these wells will occur over approximately a 25 year period of activity. Vessel activity would increase, increasing the possibility of marine mammals and vessels making contact. Some occurrences could be expected to be lethal, though in general large mammals and vessels do not make contact.

Cumulative impacts to endangered whales from OCS activities in adjacent regions are uncertain since the fin, sei, sperm, humpback, and right whales are known to occur to some degree in all three OCS lease areas bordering the Atlantic coast. The low number of estimated spills in these three areas combined with other OCS activities will probably result in some adverse impacts, including the possible loss of a few whales which could inhibit the return of each species to a nonendangered status.

Impacts that are unrelated to OCS activities but could contribute to a cumulative impact on humpback whales include the annual subsistence level fisheries for this species in Greenland (International Whaling Commission [IWC] quota of 8 in 1984-1985). Entrapment injury and mortality (17 killed in 1980) from inshore fishing gear along the Newfoundland coast is also a problem. The IWC has set a quota of 8 fin whales for aborigines in West Greenland. This fin whale stock inhabits waters outside U.S. jurisdiction for the most part but may interact with fin whales in U.S. waters. All other species of endangered whales in the Western North Atlantic Ocean have zero quotas as set by the IWC or are totally exempt from commercial harvests. However, some illegal hunting of whales may take place.

Canadian offshore oil drilling in the waters around Nova Scotia and Newfoundland could also have an impact on each endangered whale. The effects of Canadian drilling may be similar to those identified for drilling in U.S. waters. The cumulative effect of OCS activities and activities unrelated to OCS operations could result in a low number of additional right whale mortalities which could inhibit the return of these animals to a nonendangered status.

CONCLUSION: Cumulative activities would have a moderate level of impact on most endangered or threatened species, except the right whale which could experience a very high level of impact.

### (g) Impact on estuaries and wetlands

Potential impacts to estuaries and wetlands from OCS activities and oil spills are addressed in detail in Section IV.B.1.a(4)(g). The estuaries and wetlands in the south Atlantic area could be affected by OCS activities and oil spills in a similar manner because the general level of development is not greatly different. No acreage of coastal wetlands is expected to be filled and developed to accommodate OCS activities in the South Atlantic Planning Area as a result of the proposed action. Any oil spill that does reach the coast may pose a threat to estuaries and wetlands of which there are large numbers in the south Atlantic area. The potential extent of any damage, however, would depend upon the location, size, and weathered condition of the spill, efficiency of required oil spill cleanup equipment, and time of year of the spill. It is unlikely that the 1 assumed spill in the area would have a significant impact on estuaries and wetlands because of these limiting conditions.

CONCLUSION: A very low level of impact on estuaries and wetlands in the south Atlantic is expected from OCS activities resulting from the proposed action.

CUMULATIVE IMPACTS: Impacts associated with existing sales could have a cumulative effect with impacts anticipated from the proposed action. However, because of the minimal resource estimates for the existing leases, the cumulative probabilities of impact on the various coastal areas would be no different from those projected for the proposed action. Onshore support facilities and the number of gas pipelines are not expected to change in the cumulative case from those estimated in the proposed action. Therefore, cumulative impacts on sensitive coastal areas from proposed and existing OCS development should be unchanged from those projected for the proposed action.

Impacts that are not related to OCS activities but could contribute to a cumulative impact on estuaries, wetlands, and other coastal habitats include the loss of these habitats from private and recreational development which will pose a serious long-term threat to the viability of these ecosystems. Five oil spills over 1,000 bbl each may occur in the south Atlantic region as a result of all sources of oil transportation and development. These spills represent a moderate level of impact on wildlife conservation areas, coastal inlets, and salt marshes and wetlands.

CONCLUSION: Cumulative effects of all activities in the south Atlantic region may have a moderate level of impact on estuaries and wetlands.

### (h) Impact on areas of special concern

The areas of special concern in the South Atlantic Planning Area include the existing and proposed National Estuarine Sanctuaries in North Carolina (Rachel Carson) and Georgia (Sapelo Island) and Gray's Reef National Marine Sanctuary off of Sapelo Island, Georgia. The mangrove swamps in central and southern Florida are also areas of special concern. OCS support activities resulting from the proposed sale are assumed to be located outside of sanctuary boundaries and mangrove swamps and are not expected to have an impact on any sanctuary sites or mangrove swamps. The assumed oil spill could damage mangrove swamps or degrade a sanctuary site if they are contacted by the spill. The risk of a spill reaching these areas would be greater from a nearshore spill. However, the majority of the planning area is heavily under the influence of the Gulf Stream and would pose a very small oil spill risk to land areas. No existing OCS leases occur in the vicinity of these areas.

CONCLUSION: OCS activities should have a very low level of impact on areas of special concern in the south Atlantic region.

CUMULATIVE IMPACTS: National Estuarine Sanctuaries and National Marine Sanctuaries are protected from industrial development and consumptive uses, therefore they would be directly protected from significant cumulative impacts. However, the mangrove swamps are threatened by coastal development and water pollution from non-OCS activities. Potential oil spills from the transport of petroleum hydrocarbons through the South Atlantic Planning Area and the production and transportation of crude oil as a result of the proposed action pose an appreciable risk to these areas of special concern.

CONCLUSION: Cumulative effects of OCS and non-OCS activities are estimated to have a moderate impact level on areas of special concern.

### (i) Impact on Marine Sanctuaries

At present, there is one marine sanctuary--Gray's Reef--and two areas on the Site Evaluation List (SEL)--Ten Fathom Ledge/Big Rock and Port Royal Sound, South Carolina--in the South Atlantic Planning Area. Impacts to Gray's Reef from OCS oil and gas activities could be extensive if development or ship anchoring were to occur there because of its fragility and susceptibility to mechanical damage. In addition, Gray's Reef shallow water location would make it vulnerable to impact if it is contacted by an oil spill. A spill in the area could easily advect to the live-bottom community and cause the full spectrum of adverse effects from direct mortality to sublethal modification. However, its sanctuary status precludes direct activity on the site; however, impacts resulting from nearby (within 1,000 m) oil and gas industry activities such as drilling material discharges could occur. Overall, the risk to the area is low because its location away from the large majority of the planning area, the estimated risk of an oil spill as a result of the proposed action, and the dominance of the Gulf Steam over much of the planning area which would drift oil and effluents away from the reef. See Section IV.B.3.a.(6) for a discussion of the deferral of the Gray's Reef subarea from the 5-year program.

CONCLUSION: An overall low impact level is indicated.

CUMULATIVE IMPACT: Because of the sanctuary status of Gray's Reef, most of the impact causing agents in the south Atlantic, such as destructive fishing activity, are prevented from occurring. The possibility, however, of an oil spill resulting from the transport of petroleum through the planning area and proximal to the sanctuary is still present and would be additive to any effect of the proposed action.

CONCLUSION: Based on the potential risk to the Gray's Reef area from transported petroleums, a cumulative moderate impact level is estimated. The proposed action is expected to cause a slight increase in existing cumulative impacts but not change the impact level.

### (5) Socioeconomic Environment

#### (a) Impact on employment and demographic conditions

The search for and discovery of oil and gas resources within the South Atlantic Planning Area could create employment opportunities, and consequently increase population levels. These changes have both positive and negative attributes thereby giving an indication of the socioeconomic wellbeing of communities, counties, States, and regions.

The proposal could generate a regional total of approximately 2,100 jobs during peak activity [see section IV.B.1.a.(5)(a)] for references on the methodology used to derive estimates). This total employment figure represents less than 0.1 percent of the region's civilian labor force.

A regional peak population increase of about 5,400 persons could be associated with the projected employment increase. This represents less than 0.1 percent of the region's population, implying little or no significant stress on the public and private service and facilities of the region as a whole.

The population increase generated, while minimal on a regional basis, may not be uniformly insignificant throughout the region. Impacts are potentially more significant in those counties or independent cities in which direct investments of offshore-related primary activities may be located.

CONCLUSION: The level of activity associated with this proposal will result in a very low level of impact on socioeconomic factors on a regional basis and very low to low impact on a local basis. The only county likely to be appreciably affected is Carteret County, North Carolina where the support base facilities are expected to be located.

CUMULATIVE IMPACTS: The south Atlantic section of the United States is expected to increase in population as more people migrate toward the southern and western parts of the United States. Sunbelt growth in population is a combination of increased employment potential and retirement possibilities for individuals from the more severe winter climate sections of the United States. Expanding employment opportunities will compete with the oil and gas development of the south Atlantic region for available labor. However, specialized skills required in the oil and gas industry should not conflict with the expansion of employment in the service industries.

Population in the planning area is expected to increase by 61 percent by the year 2000 from the 1980 census figure of 10,692,691 (Department of Commerce, Bureau of the Census, 1983). The majority of this growth should be in the State of Florida where there is a high level of retirement age population. This is characteristic of the immigration toward southern and western portions of the United States.

CONCLUSION: Cumulative effects on employment and population in the planning area are expected to increase dramatically in the near future. Impacts to the planning area due to this growth are expected to be high.

### (b) Impact on coastal land uses

The nature of the scenario for the South Atlantic Planning Area and a detailed explanation of assumptions is contained in Section IV.A. Major onshore components of the scenario for the South Atlantic Planning Area include a new gas pipeline and landfall, a new gas processing and treatment plant, and the establishment of a support base for offshore operations. This support base is assumed to be located in or near Morehead City, North Carolina. No assumption has been made at this time with respect to the pipeline right-of-way and the location of the gas plant for the south Atlantic.

Virginia Beach (Camp Pendleton), Virginia; Pender County, North Carolina; Chatham County (Savannah), Georgia; and Duval County (Jacksonville), Florida, have been analyzed in previous south Atlantic lease sale EISs as potential sites for pipeline landfalls and rights-of-way. A variety of studies (e.g., VIMS, 1978 and Sorell *et al*., 1982) have examined the diverse environmental, economic, and technical variables involved, as well as legal procedures and constraints and existing State-level policies and regulations which would affect the siting of such a facility. While the pipeline route and landfall would need to avoid significant natural features or sensitive areas, it does not appear that there are necessarily major conflicts with land use in the areas involved.

Previous EISs for the south Atlantic have analyzed four different areas as possible locations for a gas processing and treatment plant including Norfolk, Virginia; Pender County, North Carolina; Savannah, Georgia; and Jacksonville, Florida. Depending upon where significant quantities of natural gas are found, any one of these locations, or possibly some other location, if more appropriate, could support the development of a gas plant which would require 50-75 acres of land. All four locations analyzed contain heavily industrialized areas suitable for a gas plant, have clearly delineated industrial siting procedures, and in some cases the State has conducted studies which identify a number of specific sites for such a facility.

A support base is hypothesized to be located in the vicinity of Morehead City, North Carolina. Previous EISs have examined the potential land-use impacts of a support base in this area. A study of potential OCS support bases (Cribbins, 1981) identified four sites in the Morehead City-Beaufort area which might be suitable for a support base, at least one of which already meets most of the port and marine service infrastructure requirements. Because the existing sites are already industrial, it does not appear that site approval would be difficult to obtain. Adherence to local codes and permitting procedures will ensure compliance with local land-use plans and coastal zone management programs.

The scenario for this lease offering assumes that oil will be recovered via single-point mooring systems and then transferred to tankers for transport to refineries in the Delaware Bay area. No expansion of refineries would be required and thus, conflict with any land-use plan or policy would be unlikely. It has also been assumed that the pipecoating needs for the south Atlantic would be fulfilled by existing Gulf of Mexico facilities. No expansion would be required thereby eliminating the potential for land-use conflicts. Helicopter support services could be located in any existing commercial airport along the coast. The locations of these helicopter bases will change, depending upon the proximity to offshore activity at a given time. By their nature, these bases are highly mobile and would only require a small office (in terms of physical needs) which could be located in an existing terminal building.

CONCLUSION: Impacts on land use in the south Atlantic coastal area are expected to be moderate. All facilities associated with the proposed action are anticipated to be accommodated in areas of compatible land uses.

CUMULATIVE IMPACTS: Cumulative impacts on coastal land use in the South Atlantic are the same in character as for the North and Mid-Atlantic Planning Areas. See Section IV.B.1.a(5)(b) for a description of these impacts.

CONCLUSION: Impacts on coastal land use could be high or very high in the cumulative case.

### (c) Impact on commercial fisheries

Most south Atlantic commercial fisheries occur in nearshore waters. In addition, many commercially important species such as blue crab, white shrimp, clams, oysters, and weakfish not only inhabit but also spawn in estuaries or nearshore waters. The probability of an oil spill contacting nearshore areas throughout the south Atlantic is very low. However, nearshore resources are very sensitive to impacts from oil spills. Obviously, clam and oyster beds have no avoidance mechanism to spills, and species such as crabs have only limited mobility. In addition, oil introduced into rather confined areas, such as bays, sounds, and estuaries, can be expected to dissipate more slowly than oil spilled in the open ocean.

Habitual discharges of drilling muds and cuttings, formation waters, and other incidental contaminants are anticipated to occur as a result of exploration and development activity. Studies conducted and/or summarized by several researchers such as SAI (1982), Grizzle (1983), Boland (1983), and NRC (1983) indicate that potential impacts on fishery resources from chronic discharges are quite low. This is especially true in the south Atlantic where the majority of the commercially valuable finfish and shellfish occur in nearshore waters away from anticipated oil and gas activity.

The economic impact on commercial fisheries in the south Atlantic resulting from spatial exclusion because of rig and/or pipeline placement is expected to be low. The gas trunkline is expected to use a corridor of approximately 221 km2 (85 mi2, 22,100 hectares) or about 0.23 percent of the area shallower than 200 m in the south Atlantic area. This is expected to have a very minimal effect on commercial fishing.

The possibility of conflicts arising between the fishing and oil and gas industries is greatest in fishing ports which have been identified as possible OCS support bases. Both Morehead City/Beaufort, North Carolina and Brunswick, Georgia, the two ports assumed as OCS support bases in the proposed Sale No. 90 scenario, are important fishing ports.

If the oil and gas resources are concentrated in the southern part of the planning area, Brunswick, Georgia would be the assumed service base. Because dock space is very limited during the shrimp season (April-December), space-use conflicts could arise between the fishing and oil and gas industries. If there is a commercial find, new dock facilities might have to be constructed at the 110-acre former Babcock and Wilcox site. The area is now unoccupied and has been identified as a possible permanent support base. Overall port congestion is not a problem in the Brunswick area. Even a significant increase in vessel traffic would not have a negative impact on the fishing industry. The two existing boat yards in Brunswick are associated with fish houses and would not be used by vessels engaged in OCS activities.

If the oil and gas resources are concentrated in the northern block group, Beaufort/Morehead City, North Carolina is expected to be the service base. Commercial fishing vessels, charter boats, and private recreational boats all use the port of Beaufort/Morehead City. All three, however, have facilities which are geographically isolated. Because OCS vessels would probably use space available at the State Port Authority docking facility in Morehead City, it is doubtful that there would be conflicts for space with vessels of the local fishery. The State Port Authority does not provide berthing space to fishing vessels.

Of the 10 most economically important south Atlantic commercial fisheries, only the swordfish fishery occurs in deeper waters. The other shellfish and finfish are harvested in estuaries, sounds, shelf, and coastal waters. While it is true that nearshore fishery resources are the most valuable in the south Atlantic, several commercially harvested species do occur offshore. These species include mackerel, tilefish, whiting, livebottom species such as snappers and groupers, and royal red shrimp, which have sensitive egg and larvae stages present in surface waters. While these stages occur throughout the year, they are especially apparent during the winter when such commercially important species as brown shrimp, menhaden, flounder, croaker, and spot are spawning. An offshore spill which occurred within the area could produce significant egg and larvae mortalities of many commercially important species. Early life stage mortalities are extremely important in determining potential impacts on commercial fisheries. Hennemuth _et_ _al_. (1980) reviewed several commercial fisheries with extensive data collected over many years. This study concluded that comparison and recruitment estimates and associated catches over time (years) indicated that significant deviations in catch closely followed significant deviations in recruitment. This indicates that reduced recruitment resulting from egg and larvae mortalities, either man-induced or natural, translates into reduced landings. This same concern for early life stage mortalities was expressed by Teal and Howarth (1984) who suggested that although adult fish can be killed by oil spills, mortalities to adult fish probably poses less of a threat to commercial fisheries than does damage to eggs and larvae, or changes in the ecosystem supporting the fishery.

Cross et al. (1984) performed some calculations of potential impacts on the menhaden fishery, which represents the greatest volume of landings in the south Atlantic. Assumptions used in modeling were for a major oil well blowout off the North Carolina coast during the winter. Wind data used predicted that the prevailing northeast winds would transport both oil and larvae shoreward. The spawning area off North Carolina is of particular importance because fishing pressure has reduced the proportion of older fish in the population. The model assumed that the survival rate in the 0-age class is reduced 50 percent below the equilibrium level for that age class. Other age classes were modeled at their 20-year average survival rate. The conclusions of this investigation were that the simulation indicated that total biomass would be reduced by about 12 percent over 30 years relative to the initial level. Because the model did not include a density-dependent compensation mechanism, a percentage compensatory adjustment was included instead. It was assumed the population had both high (80 percent) and low (20 percent) biological reserves to compensate for a one-time early life stage catastrophic event. Using these compensatory factors, it was concluded that long-term reductions in stock size of 2 percent and 9 percent for high and low levels of compensation occurred. Compensatory rates were much different because Atlantic menhaden exhibit variable and periodically quite large year classes as a result of variable survival rates in the 0-age class (Peters and Schaaf, 1981).

If the landings of menhaden were to decline by the same amount predicted for the total stock (2 to 9 percent), this would result in reductions between approximately 6,500,000 to 29,000,000 pounds, which translates to between approximately $200,000 to $1,000,000 (1981 values used as the base). If these model assumptions and predictions are accurate, results of this magnitude could be significant.

An important deeper-water resource harvested by south Atlantic commercial fishermen are the royal red shrimp. If a spill should occur from blocks close to this resource, the potential for contacting these grounds is quite high. This could produce larval mortalities at nearly any time of the year because royal red shrimp demonstrate year-round spawning, and the center of abundance is relatively fixed since this species is not highly mobile. A spill that occurred in waters proximal to these grounds could result in overall population reductions, lasting for at least one generation.

CONCLUSION: The overall impact to commercial fishing is expected to be low.

CUMULATIVE IMPACTS: Cumulative impacts on south Atlantic finfish and shellfish species of commercial and sport fishing importance can be evaluated by projecting impacts associated with the proposed action, existing leases, and tanker transport of foreign oil (both refined and crude). In addition to these factors, cumulative impacts on commercial and sport fishery resources are produced by fishing pressure and exposure to environmentally hazardous conditions in other areas contacted during extensive north-south migrations demonstrated by some south Atlantic fishery resources.

Activity from existing leases will result in more rigs and platforms, and therefore, more drilling discharges than for the proposed action alone. Despite this increased activity, drilling discharges in total, are anticipated to be a low level cause of impact.

Commercial fishing does not represent the impact to fish resources that is evident in the North and Mid-Atlantic Planning Areas. Typically, commercial fishing would be classified as a low-level impact.

CONCLUSION: The cumulative impact to commercial fisheries resources is expected to be low.

#### (d) Impact on recreation and tourism

Land-use competition, visual effects, and oil spill impacts are the three major concerns relating to recreation and tourism in the coastal south Atlantic. The nature of such concerns are examined in some detail in the north Atlantic section on "Impact on Recreation and Tourism" [Section IV.B.1.a.(5)(d)]. Much of the information and conclusions contained therein is equally applicable to the affected States of the South Atlantic Planning Area.

The scenario for exploration and development of the South Atlantic OCS calls for a new gas processing and treatment plant and a gas pipeline right-of-way and landfall. It has been determined that ample locations are available in the coastal South Atlantic to accommodate such facilities [see Section IV.B.3.a.(5)(b)]. These and other onshore facilities supporting offshore oil and gas activities can be accommodated without necessarily conflicting with coastal recreation. In addition, any onshore facilities would be sited in accordance with applicable Federal, State, local, and coastal zone land-use policies [see Sections IV.B.3.a(1)(a) and IV.B.3.a(5)(b)]. It is thus unlikely that any such facilities would be sited in an area used or suitable for coastal recreation.

As detailed in Section IV.B.1.a.(5)(d), unless offshore facilities such as the scenario's 1 platform and 46 wells are located in the most shoreward portions of the planning area (at least 3 miles offshore), which is unlikely, the potential for onshore visual impacts from OCS exploration in the Mid-Atlantic Planning Area is quite small or nonexistent.

The potential for oil spill impacts to coastal recreation is also quite small, even with the assumption that a spill resulting from the proposed action will occur in the South Atlantic Planning Area. The bulk of what risk does exist is the product of potential nearshore tanker spills or potential accidents from the very unlikely placement of production facilities in nearshore areas.

CONCLUSION: The proposed action's impacts on coastal recreation and tourism are anticipated to be very low. Although certain local areas may experience low or possibly moderate impacts in the unlikely event of oil spill contact, overall impact on the region should remain very low.

CUMULATIVE IMPACTS: Long-term development pressures may create land-use conflicts with recreational resources. It is anticipated however that State and local land-use plans and policies and coastal zone management programs will be effective in controlling development and reducing conflicts.

In the cumulative case, existing levels of tanker transportation of crude oil and refined products through the area (levels which are expected to continue) create substantially greater risk of oil spillage and a resulting greater likelihood of spill contact with coastal recreation resources.

Although certain local areas may be adversely affected by an oil spill if one should occur, tourism and recreation is a well established industry in the coastal South Atlantic area and is expected to remain as such. There are no predictable factors, including OCS activities, which are anticipated to depress the tourist industry or displace its role in the area's economy.

CONCLUSION: In the cumulative case, the potential exists for moderate impacts to coastal recreation areas. These impacts, resulting from oil spills, would tend to be local in nature, not extending over the region as a whole.

### (e) Impact on archaeological resources

#### (i) Prehistoric archaeological resources

The earliest undisputed date for man's occupancy of the North American Continent east of the Appalachians is approximately 12,000 BP (years before present). Sparse sea-level data in the south Atlantic have encouraged the conservative estimate of the 12,000 BP shoreline as equivalent to the present day 40-m isobath. Shoreward of the 12,000 BP shoreline, the potential for prehistoric archaeological resources exists. These resources include aboriginal artifacts (such as stone bowls and tools), which may occur singly or in clusters, and habitation sites.

OCS oil and gas activity may have both negative and positive impacts on prehistoric archaeological resources. During the geophysical and geological evaluation phase of exploration activities, both positive and negative impacts are possible. Seismic surveying and bottom sampling may result in identification of previously unknown sites thus providing a benefit to archaeological research. On the other hand, bottom sampling could also result in the disturbance of buried resources. Because archaeological interpretation is heavily dependent on the relative placement of artifacts within a site, such disturbances could be very damaging.

The majority of possible impacts during the exploration and development phases are negative in nature. Rig and platform installation could disturb both surface and buried resources. Drilling muds, cuttings, and formation fluids may damage sites by chemical activity but also could afford protection by burying the site.

Based on information obtained from pre-drilling surveys, lessees would be able to take actions which would avoid or lessen many potentially negative impacts on prehistoric archaeological resources. In some cases, however, indica-tors of archaeological sites (e.g., shell middens) are sometimes hard to detect and, therefore, adverse effects by oil and gas activities may result.

If blocks within the zones of greatest archaeological potential are leased, prehistoric resources which may be present in those blocks could be affected by oil and gas activities. However, because there are no known prehistoric sites in this area, it is very difficult to quantify the expected level of impact.

While 17 percent of the South Atlantic Planning Area is shoreward of the 12,000 BP shoreline, hence having the potential for prehistoric archaeological resources to exist, the actual extent of the planning area with the potential for containing prehistoric archaeological resources is much lower. This is attributed to the high amount of erosion that has taken place off North Carolina and Florida during the transgression which followed the Wisconsin glacial retreat. Also, only a low level of activity is projected with only 1 platform assumed in the mean case scenario; historically, this activity has been directed toward deeper water.

Consequently, the overall impact of the proposal on prehistoric resources occurring within the area is expected to be low. In addition only 1 gas pipeline is projected for the planning area. Should an archaeological site be located within the pipeline corridor, damage to or destruction of the resource could occur. However, in the south Atlantic there is usually a fair amount of sediment cover over landforms which might contain prehistoric sites, minimizing danger to the potential sites. Consequently, only a low level of impact on prehistoric resources located along pipeline rights-of-way is expected.

Prehistoric sites located in tidally influeced areas, on the other hand, could be severely affected by an oil spill. Oil could contaminate prehistoric artifacts and oil spill cleanup operations could disturb or destroy artifacts. Processing and storage facilities at onshore locations could result in the damage or destruction of prehistoric archaeological resources. However, the probability of this occurring is remote as State and environmental regulatory agencies have opportunities to review plans for onshore development related to offshore oil and gas activity.

### (ii) Historic archaeological resources

Historic archaeological resources include shipwrecks or sunken aircraft offshore, or historic buildings, sites, bridges, and districts onshore.

The potential for impacts on historic archaeological resources in the South Atlantic Planning Area is greatest around the shoals of the North Carolina capes and Cape Canaveral, Florida, the port areas of Charleston, South Carolina, Brunswick, and Savannah, Georgia and St. Augustine, St. Lucie Inlet to Sebastian Inlet, and Biscayne Bay, Florida. Shipwreck concentrations off North Carolina and Florida south of Sebastian Inlet are shoreward of the 40-m isobath; ship-wreck concentrations off South Carolina, Georgia and Florida north of Sebastian Inlet are shoreward of the 20-m isobath.

Potential impacts on shipwrecks are both positive and negative in nature. As with archaeological artifacts, exploratory activities might result in identification of previously unknown wrecks. However, the magnetic signature of the dispersed remains of a shipwreck could easily be masked by a platform or pipeline near the shipwreck. Any objects placed on the ocean floor may crush a fragile wooden wreck. Finally, spilled oil could contaminate a shipwreck and oil spill cleanup operations could damage or destroy a wreck.

Many potentially negative impacts on historic archaeological resources could probably be avoided through the use of information obtained during pre-drilling surveys. Shipwrecks could be located through pre-drilling surveys required under OCS Operating Order No. 2, and, once identified, could be avoided by means of directional drilling and other techniques.

Because shipwreck data are rather limited, it is very difficult to quantify the expected level of impact. However, areas known or expected to contain heavy concentrations of shipwrecks are shoreward of the areas which have received the most industry interest. Also, a low level of activity is projected for the proposed lease sale with only 1 platform assumed in the mean case scenario. Consequently, the overall impact of the proposed lease sale on historic resources is expected to be low.

If a shipwreck is located in the path of the natural gas pipeline, damage to or destruction of the resource could occur. However, before a pipeline route is actually decided upon, a survey would be required. Such surveys, conducted with sidescan sonar, sub-bottom profiler, and possibly magnetometer, could locate many shipwrecks which might be present in the proposed corridor. The pipeline could then be realigned in order to avoid possible conflicts.

Because the majority of historic structures in the immediate tidal zone are protected by bulwarks or other barriers, damage from an oil spill would be largely esthetic in nature. Additionally, any historic sites eligible for, or listed on, the National Register of Historic Places are afforded protection under the National Historic Preservation Act of 1966, as amended. The siting of OCS-related facilities at onshore locations could adversely affect historic archaeological resources. However, because State and environmental regulatory agencies have opportunities to review plans for onshore development related to offshore oil and gas activity, the probability of this occurring is very remote.

CONCLUSION: Impacts on archaeological resources located within the planning area, in onshore areas, and along pipeline rights-of-way are expected to be very low.

CUMULATIVE IMPACTS: While in the cumulative case there are expected to be 22 platforms and 55 workboats, activities not associated with OCS oil and gas development would appear to present a higher probability of negative impact on archaeological resources, both prehistoric and historic, within the South Atlantic Planning Area. Such activities include the transport by tanker of crude and refined petroleum imports through the region, onshore facility construction, trawling, sport diving and commercial treasure hunting, and channel dredging. Because there is a greater probability of an oil spill resulting from the continued importation of oil at present levels, historic shipwrecks and/or prehistoric sites could be contacted by an oil spill. Subsequent cleanup operations could damage or destroy the wrecks and/or sites. Construction of non-OCS-related onshore facilities could result in the damage or destruction of both prehistoric and historic archaeological resources. However, the impacts could be mitigated through compliance with a variety of permitting requirements, the coastal zone management programs of the affected States, and the National Historic Preservation Act of 1966. Because trawling by fishermen would affect only the uppermost portion of sediments, the risk to potential prehistoric sites would be low. With respect to historic shipwrecks, it is likely that the zone of disturbance would have already been affected by natural forces. While sport and commercial diving would probably have little impact on potential prehistoric sites, the removal of historic material from shipwrecks could be very damaging. Because most channel dredging takes place near the entrance to inlets and ports, both prehistoric and historic resources could be severely affected by such activities. This is because areas near the shoreline generally have a higher probability of containing archaeological resources than do areas further offshore. However, a mitigating measure would be the Army Corps of Engineers (COE) requirement that remote sensing surveys be conducted prior to dredging operations in many areas.

CONCLUSION: Impacts on archaeological resources could range from low to moderate because of the aggregate of varied activities occurring within the planning area.

### (f) Impact on marine vessel traffic and offshore infrastructure

Generic impacts on marine vessel traffic and offshore infrastructure (e.g. oil rigs, production platforms, and pipelines) resulting from OCS oil and gas activities are described in Section IV.B.1.a.(5)(f). There is no formalized vessel routing system in the South Atlantic Planning Area. However, many ships do follow the northward flow of the Gulf Stream, in an area where offshore drilling or structure placement may take place. However, only 1 platform is assumed under Alternative 1, with 3 supply boats servicing it. Therefore, it would appear that existing vessel traffic will have no difficulty adjusting to the siting of structures or the slightly increased level of vessel traffic within the planning area.

CONCLUSION: Impacts on marine vessel traffic and offshore infrastructure are expected to be very low.

CUMULATIVE IMPACTS: With 22 platforms and 55 workboats, the vessel activity and structure placement associated with the cumulative case represent a small percentage of all activities that may affect marine vessel traffic and offshore infrastructure. Possible increases in existing commercial vessel traffic represent the major source of potential navigational hazards.

CONCLUSION: A low level of impact on safe navigation is expected because of possible increased commercial vessel traffic not associated with OCS oil and gas activities.

### (g) Impact on military uses

The proposed action will create a conflict with oil and gas activities and NASA/DOD activities at the Kennedy Space Center (KSC) Flight Clearance Zone. These conflicts would include danger to oil and gas operators from launch activities of the Space Shuttle program and military testing of missile systems. The specific military and NASA activities which take place within the planning area are described in Section IV.B.3.a.(2)(b) (Figure III.A.3.a.6-1). However, the low level of activity associated with the mean case scenario, only 2 platforms are expected within the planning area, is unlikely to interfere with any NASA activities.

CONCLUSION: Impact on military uses is expected to be very low.

CUMULATIVE IMPACTS: The proposal represents only a small percentage of the activities taking place within the South Atlantic Planning Area that may conflict with planned military or NASA operations. To date, no serious conflicts have arisen and none are expected.

CONCLUSION: Cumulative impacts are expected to be very low.

### (6) Subarea deferrals

The following subarea is proposed to be deferred from leasing in this 5-year program.

### National Marine Sanctuary - Gray's Reef

This area covers blocks containing Gray's Reef National Marine Sanctuary which lies 17.6 nautical miles east of Sapelo Island, Georgia.

The sanctuary is a biologically productive, moderate-to-high relief, live-bottom reef. The reef supports a variety of biota including an array of seaweeds, invertebrates, fish, and turtles. The sanctuary demonstrates the subtropical community profile which is common to all live-bottom areas in the south Atlantic, and is a valuable research area for the study of reef environments.

No substantial change in impacts to water quality is anticipated. Deletion of this area would avoid any possible impacts from standard OCS oil and gas operations to Gray's Reef such as impacts resulting from discharge of drilling muds or formation waters. The potential impacts resulting from an accidental oil spill would be slightly reduced since no spill resulting from OCS operations could originate within the sanctuary.

### b. Unavoidable Adverse Impacts

Normal offshore operations associated with exploration, development, and production of hydrocarbon resources result in unavoidable adverse effects of varying degrees on water quality, plankton, benthic organisms, shellfish, finfish, commercial fisheries, marine and coastal birds, some endangered or threatened species, marine mammals, as well as coastal habitats. Conflicts with regard to land use planning also occur.

The discharge of drilling muds and cuttings would cause localized, temporary increases in suspended solids and accompanying trace metals in the immediate vicinity of drilling rigs. Discharged formation waters would cause localized, minor elevations in inorganic salts, trace metals, and hydrocarbon levels around platforms, with correspondingly reduced oxygen levels.

Oil spills and chronic discharges of oil would temporarily increase hydrocarbon levels in the water column. Oil released to the environment would disperse, undergo weathering, and in shallow areas could become entrained into the bottom sediments. Sewage discharges from rigs and platforms would increase local levels of suspended solids (organic matter), BOD, nutrients, and chlorine. Finally, temporary turbidity of the water column would be increased by pipeline placement which would cause resuspension of sediments.

It is assumed that 1 spill of 1,000 bbl or greater would occur as a result of the proposal. The quality of the surface, near-surface, and, to a lesser extent, deeper waters would be lowered temporarily by spilled oil that is not recovered. If oil is entrained in bottom or shoreline sediments, water quality degradation could continue over weeks, months, or even years as the oil is slowly reintroduced into the system or biodegraded.

Minor, temporary decreases in benthic and planktonic populations would occur in localized areas around drilling rigs because of the disposal of drilling muds and cuttings. Toxic materials used in mud mixtures may adversely affect some marine organisms in localized areas when drilling fluids and cuttings are discharged and settle to the bottom. Also, bottom sediments and biota would be temporarily disrupted by pipelaying operations.

Commercially important species may be affected by mortality to fish eggs and larvae and smothering of shellfish. Commercial fishermen would be negatively affected by spatial exclusion from fishing grounds.

Additionally, possible damage to gear and lost fishing time could occur. Spilled oil would cause localized mortalities of finfish and shellfish, particularly at early stages of their development.

Endangered or threatened species and marine mammals are not expected to suffer any major adverse impacts to their remaining populations. However, it is possible that some individual animals might be adversely affected from activities or accidents related to the proposed action. Marine and coastal birds could suffer minor losses. Sensitive coastal areas (i.e., wetlands, estuaries, and sandy beach/dune areas) could take several years to recover from oil spill impacts.

A gas pipeline landfall would cause a temporary and local disturbance of beach and wetland habitats during the construction phase. Unavoidable conflicts with land-use planning resulting from pipelaying and related disturbances would be localized and temporary in nature. The single projected gas pipeline would require onshore rights-of-way and would be buried. Approximately 75 acres of land would be needed for the construction of a gas processing plant.

### c. Relationship Between Local Short-Term Uses of the Environment and the Maintenance of Long-Term Productivity

Short-term is defined as the projected economic life of the project, and long term is defined as the period that follows the economic life of the project. The principal short-term use of the area would be for the production of oil and gas which are non-renewable resources.

Short-term adverse effects to marine biological communities would result from normal operations and oil spills. Short-term losses could include reductions in biological productivity, changes in marine habitats, and reductions in populations of plankton, benthos, fish, birds, mammals and turtles, and changes in food web components.

After the project, impacts resulting from OCS activity in the proposed sale area would not occur. To date, there has been no discernible decrease in marine productivity in OCS areas where oil and gas have been produced for many years. It has been recognized that continuous, low level pollution from toxic chemicals, including oil, may adversely affect long-term productivity, but the extent of these long-term effects cannot be quantitatively determined until reliable data become available.

Of the species in the region protected by the Endangered Species Act, marine species may suffer some short-term adverse effects. Coast oriented endangered species probably would not be affected significantly. Important feeding areas for endangered whales are currently believed to be located outside the sale area. If, in the future, feeding areas are located in the region, OCS activities may have an adverse short-term and long-term effect on the population. Migrating whales must pass through the proposed sale area. This could lead to changes in the migratory behavior of these whales. Non-endangered marine mammals would suffer only short-term effects from the proposed action.

The proposed sale will result in employment and population increases and possible short-term adverse impacts to the social infrastructure of affected communities. A strain on existing public and private services could be expected if new OCS-related facilities are located in areas of low population with little current industrial base. However, in the long term, a return to equilibrium can be expected as population gains and indirect industrial development are absorbed into the expanded communities.

Short-term adverse impacts could occur to the recreation resources and tourist industry of the area if an oil spill contacted a beach during or just prior to the season of peak use.

Short-term use of the OCS for mineral extraction would preclude fishing in the immediate vicinity of oil and gas operations. Although fishing takes place within the proposed lease area, only a small portion of the total fishing area would be removed.

In summary, short-term, localized impacts, both environmental and socioeconomic, would result from the proposed sale. No long-term productivity or environmental gains with regard to natural resources are expected as a result of this proposed sale. Benefits are expected to be principally those associated with increased domestic supplies of oil and gas and lessened dependence on foreign sources.

### d. Irreversible and Irretrievable Commitment of Resources

Development and extraction of hydrocarbons could represent an irreversible and irretrievable commitment of nonrenewable oil and gas resources. The conditional mean resource estimates for the proposed sale are 69 million bbl of oil and 1294 bcf of natural gas.

An irreversible or irretrievable commitment of biological resources and their habitats could occur in the area of a massive oil spill, or nearby areas that are subjected to chronic low levels of pollution. However, it is anticipated that an affected area would recover from a spill and that the natural flora and fauna would eventually reoccupy spill areas. Exceptions could be an irreversible or irretrievable loss of an endangered species that may result if populations of such a species are affected by an oil spill, either directly or through food contamination, or by any other disruption or disturbance such as habitat loss that may result from the proposed sale.

Human deaths and permanent disabilities from OCS offshore operations are an irretrievable loss of human resources. Energy expended and equipment used in exploring for and transportation of oil and gas reserves could constitute an irreversible and irretrievable commitment of resources.

The proposal would require land for a right-of-way for 1 natural gas pipeline and associated processing facility. Additional land for facilities stimulated in part by this proposed sale could also be required.

A decision to proceed with the proposal would result in the production of certain OCS-related goods and services. To the extent that resources would be drawn away from other uses, production of goods and services in other areas or of other types would be foregone.

### e. Impact of High Case Scenario

#### Introduction

Economically recoverable resources for the South Atlantic Planning Area are estimated at 820 mbbl of oil and 15.450 tcf of gas under the high resource estimate scenario. This represents approximately 11-12 times the resources of the the base case scenario. Exploration in this high resource scenario would begin in 1991 with intense exploratory activity continuing until 2000. Exploration activities are projected to cease after 2001. The first year of development/production wells and platforms is anticipated to be 1994 followed by periods of most activity during 1995-2003 for development/production wells and 1994-2003 for platforms.

The high resource estimate scenario calls for 217 exploratory and delineation wells, 420 development/production wells, and 11 platforms. This is a ten- to twenty-fold increase in the number of these facilities over the base case scenario. Oil produced under the high resource scenario would be loaded onto tankers from platforms or from single-point moorings connected by gathering lines to subsea complexes and transported to refineries in the Delaware Bay area. Gas produced under this scenario would be gathered by small diameter gathering pipe and fed into two trunklines for transport to an onshore gas processing and treatment plant in the south Atlantic area.

Gas facilities: Two gas processing and treatment plants are projected to be associated with the development of South Atlantic OCS resources in the high resource estimate scenario. It is anticipated that such facilities would be designed and built to accomodate the high resource estimate should such resources be discovered. As in the base case, no assumption has been made at this time as to the specific locations of these facilities.

Support bases: The high resource estimate scenario includes utilization of support base facilities in two locations, possibly Morehead City, North Carolina, and Brunswick, Georgia.

Platform fabrication and pipecoating: All platform fabrication needed under the high resource scenario will most likely occur at existing fabrication facilities in the Gulf of Mexico Region. In addition, numerous suitable facilities for pipecoating are located in the Gulf of Mexico Region and could be utilized if needed.

#### (1) Physical Environment

##### (a) Impact on water quality

Types of water quality impacts resulting from high case resource development would be the same as those described for the base case proposed action. The relative magnitude of these impacts, however, would be considerably greater as the number of wells and platforms would increase approximately 11- to 20-fold (to 637 wells and 21 platforms) (Table II.A.1-3) of that assumed for the proposed action. Consequently, the total volume of routine discharges released over the exploration and production period for the 1 sale would increase proportionately (to 9.3 million bbl of drilling muds; 2.9 million bbl of drill cuttings; 656 million bbl of formation waters; 421 million gallons of sanitary waste; 1,263 million gallons of domestic waste). However, the volume of these waste materials would still be small compared to the large volume of the receiving water. Impacts would be of a generally limited and local nature as discussed in Section IV.B.1.a(2)(a). The materials would be rapidly dispersed or diluted, and their discharge would take place within a geographically large area, spaced over a long period of time--14 years for drilling of wells and 30 years for resource production. Because of these factors, impacts on water quality from these routine discharges would be temporary and minor in nature.

The assumed number of large (> 1,000 bbl) accidental oil spills under high case resource development is 3--this being a considerable increase from the 1 spill assumed for the proposed action. In turn, there is an increase in the likelihood of spilled oil being carried (e.g., with ocean filaments) to shallower coastal areas where potential impacts on water quality are generally increased. Also, with the construction and/or operation associated with 1 new gas pipeline, 1 new gas processing plant and 1 new support base, some limited increase in onshore water quality degradation is expected.

CONCLUSION: A moderate, overall impact on water quality is anticipated from high case resource development.

### (b) Impact on air quality

Air quality impacts characteristic of potential OCS activities and the regulatory framework for pollutant emissions are reviewed in the section on air quality (IV.B.3.a(3)(b)). Major impact producing factors on air quality from OCS-related activity are the combustion of raw material, evaporative losses, internal combustion related to power generation, and refinery/processing techniques. Resource estimates in the high resource estimate scenarious for the south Atlantic are more than 11 times higher than the base case scenario, resulting in an increase in OCS activities associated with the exploration and development of these oil and gas resources. The increased OCS activities, including exploratory drilling vessels, and an onshore gas processing and treatment plant, may raise the overall level of pollutant emissions in the region. However, facilities used for exploration, development and production of OCS oil and gas are subject to DOI air quality regulations, and, when applicable, the state Implementation Plans for attaining compliance with National Ambient Air Quality Standards under the 1977 clean Air Act Amendments (see Section IV.B.3.a(3)(b)). As a result, only a marginal increase in pollutant emission levels would be anticipated in the high resource estimate scenario compared to the base case.

CONCLUSION: Under the high resource estimate scenario, impacts on air quality for the south Atlantic may increase to moderate from the low level anticipated for the proposal.

### (2) Biological Environment

#### (a) Impacts on plankton

Although there will be a large increase in the number of wells under the high-case estimates, it is not expected that an increase in impacts on plankton from drilling discharges will occur. The impacts from drilling discharges are very localized and will not affect an appreciable area in relation to the South Atlantic Planning Area. The increase in assumed oil spills of 1000 bbl or greater from 1 to 3, however, indicates that a much larger area could be affected. Generally, the phytoplankton component will only sustain minor, short-term impacts and will quickly compensate. The meroplankton component would not respond as quickly and may not compensate until the following spawning period, depending on the species involved. Overall, with regard to the potential size of each of the three spills and the spatial and temporal separation of the events, a moderate impact level is anticipated.

CONCLUSION: Under the high case scenario, a moderate level of impact on phytoplankton is expected.

#### (b) Impacts on benthos

##### (i) Intertidal

Under the high resource case the intertidal benthos at a specific land point will be subject to the placing of an additional pipeline, totaling two in the South Atlantic Planning Area. Impacts are likely to be short-term and very local. There is a high probability that 3 oil spills of 1,000 bbls or greater will occur over a 14 to 20 year period. The effects of the spills on the intertidal benthos depends on the location of the spill, quantity of oil, weathering of the oil, total amount of area contacted, and physical regime of the area. However, the locations of most of the planning area away from the coast, and the predominant currents in the area will limit most impacts.

##### (ii) Subtidal

As discussed in [Section IV.B.3.a(4)(b)] mechanical perturbations have a localized and a regional effect. Under the high resource scenario, there will be an estimated 20 platforms, 591 wells, and 1 gas pipeline in addition to the proposal. The south Atlantic benthic communities exist in a variety of substrates scattered throughout the planning area. This estimated amount of perturbation in conjunction with drilling discharges will in the most responsive of areas (soft substrate) cause moderate regional impacts. In moderate and high relief areas the mechanical perturbations and discharges would cause major effects. Considering the high probability of 3 oil spills greater than 1,000 bbl occurring, even though potentially spaced over 14 to 20 years, their effects could be major if they occurred in shallow water (< 60m). Impacts to deepwater benthos from oil spills would be low.

CONCLUSION: Under the high case scenario, impacts could be expected to be high on benthos.

### (c) Impact on fish resources

Refer to Section IV.B.3.a(4)(c) for a discussion of potential impacts on fish resources of the South Atlantic Planning Area.

Under the high case scenario, the impacts to fish resources would increase appreciably from the mean case. This is primarily because of an increase in estimated number of wells from 46 to 637, 1 additional pipeline, and an increase in assumed spills of 1,000 bbl or greater from 1 to 3. The increase in assumed spills would be the primary cause of increased impact levels.

CONCLUSION: A moderate level of impact is expected.

### (d) Impact on marine mammals

Three spills greater than 1,000 bbl, as assumed in the high case, occurring nearshore (between 3 and 50 mi.) could cause a serious disturbance to the manatee feeding grounds and habitats. Most likely considering the size of the plannning area only weathered oil if any from the spills occurring over a 14 to 20 year period would reach shore causing a low impact. The increase in the numbers of wells, platforms and discharges from the proposal are not expected to have a noticeable impact on manatees. The additional pipeline, support base and traffic, and gas processing plant could seriously encroach upon present manatee grounds. For marine mammals located further offshore (e.g., dolphins, whales), the high resource case estimates for drilling discharges and spills could degrade the water quality and taint or disturb their food stocks at the site of discharge. Increased seismic testing could affect activity and behavior patterns. A higher risk of contacting vessels will occur with the increase in service vessel traffic and tanker transport of oil through the south to the mid-Atlantic.

CONCLUSION: Nonendangered marine mammals in the south Atlantic could experience moderate impacts under the high resource scenario.

### (e) Impact on coastal and marine birds

The south Atlantic coastal marshes and wetlands support a large number of wading and migratory shorebirds. These birds could experience a major local impact from the development of 1 additional support base, 1 additional gas processing plant and the 1 additional gas pipeline under the high case scenario. The stress on seabird populations could be high if they experience contact with spilled oil or vacate feeding areas and nesting grounds due to the 3 assumed oil spills. Offshore food stocks could be tainted or disturbed at sites of drilling and discharge. Because of the size of the planning area and the daily and seasonal movements of the seabirds, effects could be expected to increase only to moderate from the low impacts of the proposed action.

CONCLUSION: Impacts on coastal and marine birds in the South Atlantic Planning Area could be expected to be moderate.

### (f) Impact on endangered or threatened species

The South Atlantic Planning Area is important to migrating peregrin falcons, bald eagles and as wood stork rookeries. The development of an additional support base, gas processing plant and the laying of a gas pipeline could impact sensitive nesting areas, resting grounds and feeding areas. Three oil spills greater than 1,000 bbl are assumed to occur in the planning area. Nearshore spills could degrade feeding areas or reach shore. Birds making contact with oil may become covered, transfer oil to the nest and eggs and ingest coated prey. High mortalities, elevated levels of stress, and long-term chronic effects could serously reduce populations.

The south Atlantic is an important summer feeding ground for endangered or threatened sea turtles, especially the green turtle. OCS activities could disrupt or displace feeding sea turtles. The 3 assumed oil spills could directly affect prey species or inhibit or prevent feeding activities. The large number of wells, platforms, and discharges could inhibit turtles from feeding or permanently exclude them from feeding grounds because of water quality degradation or presence of oil. The stress, or ingestion of oil, could cause mortalities and critical reduce populations. As discussed in Section IV.B.3.a.(4)(f), impacts from an oil spill on nesting areas will vary with the closeness, size of the spill, and time of year. Direct contamination of nests is negligible since they are located above high tide. The risk of oil reaching shore or turtles contacting it at sea would be low to moderate due to the size of the planning area and the seasonal movements of turtles through the area.
Of the seven species of endangered marine mammals which inhabit the South Atlantic Planning Area the sperm and right whales and the manatee are the most susceptible. The high level of OCS activity may affect the sperm whale which is present in the south Atlantic area year round. The right whale becomes present primarily in the fall, and the area is considered to be its winter calving ground. The manatee generally occurs only in the southern part of the area, primarily in Florida. The large increase in the number of wells, platforms and drilling discharge under the high case could impact all species, especially jeopardizing right whales during the calving season. The manatee will be susceptible to oil spills which reach shore, onshore development, and increased support vessel traffic. Though 3 oil spills of 1,000 bbl or greater are assumed to occur, considering the size of the planning area they will most likely occur at a distance offshore. The development of an additional support base, gas processing plant, and a gas pipeline could put part of the manatee's habitat and feeding grounds at risk. The contact risks due to the increase in service vessel traffic and tanker transport of oil through the south to the mid-Atlantic could endanger marine mammal populations, especially those of the right whale.

CONCLUSION: Under the high resource scenario, endangered and threatened marine mammals, seabirds, and turtles could experience moderate impacts. The right whale could experience high impacts.

### (g) Impacts on estuaries and wetlands

Sections IV.B.1.a(4)(g) and IV.B.3.a(4)(g) address the potential impacts to estuaries and wetlands and should be referred to for further detail. Under the high-case scenario, the probability of one of the 3 assumed spills of 1,000 bbl or greater reaching shore increases substantially. Increased impacts resulting from the greater number of wells are not expected to affect estuaries and wetlands in the area. Because of the protected nature of most estuaries and wetlands in the south Atlantic area, the probability of severe impacts resulting from a spill is fairly low.

CONCLUSION: The level of impact under the high-case proposed action increases to a low level from a very low level in the mean case.

### (h) Impact on areas of special concern

The areas of special concern in the South Atlantic Planning Area include the existing and proposed National Estuarine Sanctuaries in North Carolina (Rachel Carson) and Georgia (Sapelo Island) and Gray's Reef National Marine Sanctuary off of Sapelo Island, Georgia. The mangrove swamps in central and southern Florida are also areas of special concern. OCS support activities resulting from the proposed sale are assumed to be located outside of sanctuary boundaries and mangrove swamps and are not expected to have an impact on any sanctuary sites or mangrove swamps. The assumed 3 oil spills of 1,000 bbl or greater could damage mangrove swamps or degrade a sanctuary site if it is contacted by the spill. The risk of a spill reaching these areas would be greater from a nearshore spill. However, the majority of the planning area is heavily under the influence of the Gulf Stream and would pose small oil spill risk to land areas. No existing OCS leases occur in the vicinity of these areas.

CONCLUSION: OCS activities should have a very low level of impact on areas of special concern in the south Atlantic region.

### (i) Impact on marine sanctuaries

At present, there is one marine sanctuary (Gray's Reef) and two areas on the Site Evaluation List (SEL) (Ten Fathom Ledge/Big Rock and Port Royal Sound, South Carolina) in the South Atlantic Planning Area. Impacts to Gray's Reef from OCS oil and gas activities could be extensive because of its fragility and susceptibility to mechanical damage. In addition, Gray's Reef shallow water location would make it vulnerable to impact if it is contacted by an oil spill. A spill in the area could easily advect to the live-bottom community and cause the full spectrum of adverse effects from direct mortality to sublethal modification. Its sanctuary status precludes direct activity on the site; however, impacts resulting from nearby (within 1,000 m) oil and gas industry activities such as drilling material discharges could occur. Overall, the risk to the area is moderate because of its location away from the large majority of the planning area and the dominance of the Gulf Stream over much of the planning area.

CONCLUSION: An overall moderate impact level is indicated.

### (3) Socioeconomic Environment

#### (a) Impacts on employment and demographic conditions

It has been estimated that under the high resource estimate scenario, economically recoverable resources would be approximately 12 times as much as the proposal for the South Atlantic Planning Area. Total employment increases are expected to increase roughly in proportion to increases in resources. However, some economies of scale can be reasonably assumed so as to cause the increase in employment to be somewhat less than the increase in resources. The number of jobs created under the high resource estimate scenario (both direct and secondary) of 10,400 would still represent less than 0.5 percent of the current regional employment level.

A regional peak population increase of 26,900 persons could be associated with the projected employment increase. This represents less than 0.35 percent of the region's population, implying little or no significant stress on the public and private service facilities of the region as a whole. Impacts are potentially more significant in those counties or independent cities in which direct investments of offshore-related primary activities may be located.

CONCLUSION: Employment increases related to the high resource estimate scenario would have a negligible impact on the size and character of the region's labor force. Impacts at the local level would be minor. Impacts on population are expected to be negligible at the regional level and minor at the local level.

#### (b) Impact on coastal land use

More onshore facilities associated OCS exploration and production in the South Atlantic Planning Area are anticipated to be developed for this high resource estimate scenario than for the proposal's scenario. Two, rather than one, pipeline landfalls and gas processing plants are hypothesized along with an additional support base facility, possibly in Brunswick, Georgia. Platform fabrication and pipecoating facilities in the Gulf of Mexico area are anticipated to be sufficient under this scenario.

As reviewed in Section IV.B.3.a(5)(b), four potential pipeline landfall sites (with nearby sites for gas processing and treatment plants) have been analyzed in previous lease sale EIS's and other studies. All have been found capable of supporting the development of such facilities. A Brunswick, Georgia, site has previously been used by Exxon and Getty Oil Company as a support base location for South Atlantic exploration. Additional nearby waterfront land is available for this site to accommodate a permanent support base should the need arise. The City of Brunswick and appropriate authorities have strongly encouraged its use as a support base in the past.

It is anticipated that new facilities would be designed and built to accommodate the high resource estimate scenario should such resources be discovered. These facilities are not anticipated to substantially increase the level of impact on the affected area over what is anticipated for the proposal.

CONCLUSION: Although more land-use-related activities are anticipated to occur in the high resource estimate scenario, this should not alter the overall level of impact to the affected area. Facilities such as the gas pipelines and processing plants are anticipated to have the same moderate impacts on land use in south Atlantic coastal areas as for the proposal. These and all other facilities which may be proposed are expected to be sited in generally compatible areas. Detailed siting approval and procedural requirements are expected to mitigate those impacts which may occur.

### (c) Impact on commercial fisheries

Section IV.B.3.a(5)(d) should be referred to for a complete discussion of potential impacts. Under the high-case estimates, it is estimated that two gas pipelines would be required. In addition, a significant increase in the number of wells (from 46 in the mean case to 637 in the high case) would be anticipated. Although this is an appreciable increase in the area of potential exclusion of commercial fisheries, a maximum of approximately 1.8 percent of the area between the territorial limit and the 200-m isobath would be affected. In the south Atlantic area, the vast majority of commercial fisheries are located landward from the 3-mile limit. The potential for relatively greater impacts to occur is present for those commercial species of limited commercial distribution; such as the calico scallop (*Argopecten gibbus*) or royal red shrimp (*Hymenopenaeus robustus*). The most severe impacts to commercial fisheries could be sustained from the 3 assumed oil spills of 1,000 bbl or greater. The high probability of a large spill occurring, combined with the possibility of it coinciding with the recruitment season of valuable fish species, dictate that a potential high-level impact may occur under the high resource estimates.

CONCLUSION: A high-level impact is anticipated under the high resource estimates.

### (d) Impact on recreational resources

The types of impacts on coastal recreation and tourism in the affected area of the south Atlantic resulting from visual effects, oil spills, and land use would be the same for the total development scenario as for the proposed action [Alternative 1, see IV.B.1.a(5)(e) and IV.B.3.a(5)(e)]. Under this total development scenario, 2 pipeline landfalls, rather than 1, are hypothesized. The potential for temporary removal of coastal land resources from recreational uses is thus increased. Impacts of pipeline landfalls on coastal recreational resources are analyzed in IV.B.1.a(5)(e) The resource estimates for the total development scenario indicate almost a 12-fold increase in the amount of oil which might be produced in the south Atlantic. Under the proposed action--mean case, one spill (greater than 1,000 barrels) from all sources is assumed to occur. This assumed number of spills is increased to 3 for the total development scenario. Consequently, the relative risk of oil spill contact with coastal recreational resources is also increased. Although this risk is increased when compared to the proposed action (mean case), the likelihood of spill contact with such resources remains quite small. It is not anticipated that oil spill impacts under the total development scenario will differ substantially from the impacts anticipated under the proposed action--mean case.

CONCLUSION: Impacts upon coastal recreation and tourism in the case of total development are anticipated to be very low. Although certain local areas may experience low or possibly moderate impacts in the unlikely event of oil spill contact, overall impact on the region should remain very low.

### (e) Impact on archaeolgoical resources

High case projections for the South Atlantic Planning Area call for 21 platforms as opposed to 1 in the proposal; additionally the number of pipelines will increase from 1 to 2. Most of this activity will probably concentrate on the outer shelf and slope, where industry has shown the most interest. Surveys required prior to drilling or laying pipeline would reduce the chance for impact. In the high case, impacts to archaeological resources should increase only slightly over the proposal.

CONCLUSION: Impacts to archaeological resources will increase from very low to low.

### (f) Impact on marine vessel traffic and offshore infrastructure

Generic impacts on marine vessel traffic and offshore infrastructure resulting from OCS oil and gas activities are described in Section IV.B.2.a(5)(h). There is no formalized vessel routing system in the South Atlantic Planning Area. However, many ships do follow the northward flow of the Gulf Stream, in an area where offshore drilling or structure placement may take place. Twentyone platforms are assumed in the high case scenario, with 53 supply boats servicing them. The existing vessel traffic will have no difficulty adjusting to the siting of these structures or the slightly increased level of vessel traffic within the planning area.

CONCLUSION: Impacts on marine vessel traffic and offshore infrastructure are expected to be very low.

### (g) Impact on military uses

The proposed action will create a conflict with oil and gas activities and NASA/DOD activities at the Kennedy Space Center (KSC) Flight Clearance Zone. These conflicts would include danger to oil and gas operators from launch activities of the Space Shuttle program and military testing of

missile systems. The specific military and NASA activities which take place within the planning area are described in Section IV.B.3.a.(2)(b) (Figure III.A.3.a.G-1). The level of conflict between NASA/DOD and oil and gas activites generated by this proposed action is expected to be low. Most of these conflicts have traditionally been mitigated by negotiation between NASA/DOD and DOI.

CONCLUSION: The level of impact on military uses that will occur from the proposed action is low.

### f. Alternative II - Subarea Deferrals

This alternative evaluates the deferral from leasing in the 5-year program of eight additional subareas (14 subareas are deferred under Alternative I - The Proposed Action). Two of the additional subareas are contained wholly or partially in the South Atlantic planning area.

#### (1) Flight Clearance Zone of the Kennedy Space Center

The John F. Kennedy Space Center (KSC) at Cape Canaveral in Florida is a NASA installation. The flight clearance zone for this facility lies off the coasts of southern Georgia and northern Florida, extending from the immediate coastline eastward out into water depths as great as 2,000 m.

The area covered by this zone encompasses parts of the geological features known as the Florida-Hatteras Shelf (400 m) and Blake Plateau (600 to 1,000 m). The shelf surface is not flat but characterized by numerous sand ridges which trend at low angles to the coast. Other irregularities include scattered outcrops of live bottoms. The Blake Plateau is generally broad and flat and characterized by terrace like intervals found at 800, 900, 1,000, and 1,100 m. The western margin is characterized by the appearance of live, deep-water coral mounds. The Florida-Hatteras Shelf has been delineated into three subtidal sand-bottom assemblages; 0 to 20 m (turbulent zone), 40 to 120 m (outer continental shelf) and 160 to 205 m (upper continental shelf). The sand dollar *Mellita quinquiesperforata* and polychaetes dominate the turbulent zone. The outer and upper zones are dominated by species of polychaetes and amphipods. The continental slope area is considered to be depauperate in comparison to the shelf. The deeper region between 400 to 1,000 m is an area known for sport fishing of "blue water" species. Other than some tuna that exhibit schooling behavior, many species occur either singly or in pairs. There also exists distinct deep-water fauna such as anglerfish, rattails, hakes, and deep-sea synaphobranchid eels. Generally, these species are distributed in discrete depth zones.

Numerous space satellites are launched from the KSC each year, and it is the primary location from which the space shuttle is launched. Shuttle launches are currently taking place at a rate of approximately one every three months, but are expected to increase in frequency to eighteen per year by 1988. The military uses the Eastern Space and Missile Center, also located at Cape Canaveral, to test various types of missiles. The flight clearance zone is also used for submarine missile launch activities.

This subarea deferral would eliminate any area use conflicts between NASA/DOD operations associated with the KSC or the Eastern Space and Missile Center. This deferral would also eliminate all potential for onshore visual impacts to the coast of Florida resulting from offshore drilling facilities. The risk of impacts to coastal recreation areas from platform spills would also be substantially reduced. Overall, water quality impacts would remain unchanged. Potentially high impacts to local coastline and especially embayments within the planning area, as a result of a large oil spill, would be reduced to a low level. Deletion of the entire area would avoid possible local impacts on live-bottom assemblages resulting from direct platform placement. Local spillage with possible impacts on fish communities, marine mammals, and turtles would also be avoided. Because of the influence of the powerful Gulf Stream, it would be very unlikely that oil spilled outside this area would be transported into the area, therefore, impacts associated with oil spills would be avoided.

This subarea deferral would eliminate any potential for onshore visual impacts to the Florida coast between Cape Kennedy and Daytona Beach resulting from offshore drilling facilities. The risk of impacts to coastal recreation areas from platform spills would also be slightly reduced. This deletion would not likely change the overall potential impacts to water quality within the planning area. However, it would substantially reduce the high potential impacts from a large oil spill to a low level for the coastline and embayment areas along this part of northern Florida. Deferral of this area would avoid possible local impacts to nearshore shallow water communities and eliminate the low potential impacts to local deep-water areas. No change in regional impact levels is expected. Deferral of this area would eliminate potential use conflicts in the flight clearance area between OCS oil and gas actiities and NASA activities.

### (2) Atlantic Coast Nearshore Block Deferral

This subarea consists of a 15 mile buffer zone along the coasts of the North, Mid-, and South Atlantic planning areas. In the South Atlantic, the area (approximately from Cape Lookout, North Carolina, to Fort Pierce, Florida) consists predominantly of live bottoms and soft sands. Live bottoms appear as low, moderate, or high relief reefs. Low-relief live bottoms are generally found between the 15- 30-m isobaths, are widely distributed across the shelf, and are susceptible to periodic covering by sand veneer. They appear as smooth, flat-lying substrates. These areas can be live bottoms with sparse to moderate occurrence of sessile epibenthos, principally sponges, soft corals (octocorals), and some hard corals. Moderate relief live bottoms occur as irregular and discontinuous rocky outcrops. Their highest frequency of occurrence is between the 30- to 60-m isobaths; they are generally widespread, but are most commonly found off north Florida and the Carolinas on the middle shelf. These live bottoms may support abundant benthic species (mostly sponges, octocorals, algae, amphipods, polychaetes, and hard corals) and pelagic or reef fish communities. High-relief or shelf-edge reefs are restricted to the shelf edge between approximately the 30- to 100-m isobaths and occur as discontinuous ridges. Live-bottom communities of principally sponges, octocorals, algae, and hard corals occur with the typically associated vertebrate and other invertebrate fauna. Sand or soft bottom areas are scattered. The taxa of major importance are widely distributed, with echinoderms the most commonly observed. Large aggregates of sea urchins and sea cucumbers occur at mid-shelf and shelf edge locations. Fish nesting sites have been observed concentrated below the shelf break off North Carolina. Schooling fish occur over soft- and hard-bottom areas.

The area between 27°30'N to 29°N and 79°56'W to 80°02'W is the only known area for Oculina coral banks which are unique areas providing habitats for many speices. Individuals colonies exist off North Carolina and on the U.S.S. Monitor. This area is thought to be used by some marine mammals as feeding, breeding, and/or calving grounds as well as a migratory route to the north. Species of marine turtles are known to nest on south Atlantic beaches. The loggerhead, green, and Kemp's ridley turtles prefer the shallow coastal waters, but can occur more than 100 mi offshore, which is the preferred area of leatherback turtles.

Deferral of this subarea would eliminate all potential for onshore visual impacts to the coasts of North Carolina, South Carolina, Georgia, and Florida, resulting from offshore drilling facilities. The risk of impacts to coastal recreation areas from platform spills would also be substantially reduced.

This deferral would substantially reduce potential water quality impacts which may result from a large oil spill. Potentially high impacts to coastline and especially embayments within the planning area would be reduced to a moderate level.

Deletion of the entire area would avoid possible local impacts on live-bottom assemblages resulting from direct platform placement. Local spillage with possible impacts on fish communities, marine mammals, and turtles would also be avoided.

### g. Alternative III - Add a Sale in the Straits of Florida

The addition of a lease offering in the Straits of Florida will increase the volume of tanker traffic through the south Atlantic to mid-Atlantic ports. This increase in traffic will cause a corresponding increase in the probability of an oil spill occurring in the south Atlantic region (Table IV.A.4.a.1. and Table IV.A.4.a.4). This increase in probability will not be large enough to increase the expected number of oil spills for this area however, because the development action would be in the Straits. Therefore, the impact levels will stay the same as the proposed action for the following categories:

- Physical Environment
  - Water Quality
  - Air Quality

- Biological Environment
  - Intertidal Benthos
  - Subtidal Benthos
  - Fish Resources
  - Estuaries and Wetlands
  - Areas of Special Concern
  - Marine Sanctuaries
  - Coastal and Marine Birds
  - Marine Mammals

- Socioeconomic Environment
  - Employment and Demographic Conditions
  - Coastal Land Uses and Water Services
  - Commercial Fisheries
  - Recreational Resources
  - Marine Vessel Traffic and Offshore Infrastructure
  - Archaeological Resources
  - Military Uses

For the category of endangered and threatened species, oil and gas activities in the Straits of Florida could have a negative effect on the populations of species that migrate through the South Atlantic.

### h. Alternative IV - Biennial Leasing

A biennial leasing program would increase the number of lease offerings in the South Atlantic Planning Area by one sale. The result would be one lease offering in 1988 and one in 1990 (Table IV.B.3.h-1). The timing of the lease offering in 1988 is different from the proposal in that the first sale has been moved up one year. The lease offering in 1990 would be in addition to the proposal, and has been created by the biennial leasing alternative. Despite the addition of a lease offering, the total number of oil spills expected for the South Atlantic will remain the same as for the proposal. because the level of likely production does not change appreciably. The addition of a lease offering would increase the expected number of platforms by one, but locally and planning areawide, this would not increase the impact levels over those described for the proposal in the following categories (Table IV.A.1-1, Table IV.A.4.a.1, Table IV.A.1-5, and Table IV.A.4.a.5):

- Physical Environment
  - Water Quality
  - Air Quality

- Biological Environment
  - Intertidal Benthos
  - Subtidal Benthos
  - Fish Resources
  - Marine Mammals
  - Seabirds
  - Endangered and Threatened Species
  - Estuaries and Wetlands
  - Marine Sanctuaries
  - Areas of Special Concern

- Socioeconomic Environment
  - Military Operations
  - Archaeological Resources
  - Marine Vessel Traffic and Offshore Infrastructure
  - Employment and Demographic Conditions
  - Commercial Fisheries
  - Coastal Land Uses and Water Services
    Recreational Resources

Table IV.B.3.h-1. Schedule of lease offerings for a. The Proposal, and b. Biennial Leasing in Planning Areas other than the Central and Western Gulf of Mexico. (An X indicates that a lease offering has not been numbered.)

Alternative I - The Proposal

| Planning Area | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| North Atlantic | | Sale 96 | | | Sale X |
| Mid-Atlantic | | | Sale X | | |
| South Atlantic | | | Sale 108 | | |

Alternative IV - Biennial leasing in Atlantic OCS Planning Areas

| Planning Area | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| North Atlantic | | Sale 96 | | Sale X | |
| Mid-Atlantic | | Sale X | | Sale X | |
| South Atlantic | | Sale 108 | | Sale X | |

### i. Alternative V - Acceleration Provision

If the acceleration provision is applied to the South Atlantic Planning Area, the result will be one lease offering in 1988 (Table IV.B.3.i-1). This is different from the proposal because the timing of the offering will be moved up by one year, from 1989 to 1988 without new sales occuring. Impact analyses show that this alternative will not have an appreciable effect on the impact levels identified for the proposal because the number of oil spills and platforms will remain the same as for the proposal (Table IV.A.1-1, Table IV.A.4.a.1, Table IV.A.1-6, and Table IV.A.4.a.6). Therefore, impact levels will not change for the following categories:

- Physical Environment
  - Water Quality
  - Air Quality

- Biological Environment
  - Intertidal Benthos
  - Subtidal Benthos
  - Fish Resources
  - Marine Mammals
  - Seabirds
  - Endangered and Threatened Species
  - Estuaries and Wetlands
  - Marine Sanctuaries
  - Areas of Special Concern

- Socioeconomic Environment
  - Commercial Fisheries
  - Coastal Land Uses and Water Services
  - Recreational Resources
  - Military Operations
  - Marine Vessel Traffic and Offshore Infrastructure
  - Archaeological Resources
  - Employment and Demographic Conditions

### j. Alternative VI - Defer Leasing in Six Planning Areas

The south Atlantic is not one of the six planning areas designated for deferral under this alternative. Therefore, this alternative is not applicable to this planning area.

### k. Alternative VII - No Action

Under the no-action alternative, impacts on the human and natural environment caused by the oil and gas activities of the proposed 5-year leasing program would not occur. Particularly, impacts on water quality, benthic organisms, fish resources, marine mammals, shore- and seabirds, and on endangered or threatened species would be avoided. In addition, the expected low levels of impacts on recreational resources, employment

Table IV.B.3.i-1. Schedule of lease offerings for a. The Proposal, and b. Application of the Acceleration Provision to all Planning Areas other than the Central and Western Gulf of Mexico. (An X indicates that a lease offering has not been numbered.)

### Alternative I - The Proposal

| Planning Area | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| North Atlantic | | Sale 96 | | | Sale X |
| Mid-Atlantic | | | Sale X | | |
| South Atlantic | | | Sale 108 | | |

### Alternative V - Apply the Acceleration Provision to Atlantic OCS Planning Areas

| Planning Area | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| North Atlantic | | Sale 96 | | Sale X | |
| Mid-Atlantic | | Sale X | | | |
| South Atlantic | | Sale 108 | | | |

(including the positive aspects of employment opportunities in the planning area), and on archaeological resources would not occur; use conflicts between NASA and military operations and oil and gas activities would also be avoided.

The no-action alternative would reduce future potential OCS domestic energy production by 69 million bbl of oil and 1,294 bcf of natural gas--the mean conditional resource estimates for Alternative I. The reduction of available energy resources could necessitate increased imports of oil and natural gas, require more stringent energy conservation by industry and individuals, and at the same time, dictate the development and utilization of alternative energy sources to replace the energy resources expected to be recovered if the 5-year leasing program were put into effect. A discussion of alternative energy sources is presented in Appendix C.

Alternative energy sources likely to be considered as a result of this no-action alternative would include crude oil and natural gas from non-OCS areas (presumably imports from foreign countries as well as domestically produced oil and natural gas), coal, hydroelectric power, and nuclear power. The most likely combination of energy sources other than OCS-produced oil and natural gas would probably consist of increased imports of oil and natural gas, domestically produced strip-mined coal, and increased conservation of energy resulting from increased prices and capital substitution. Possible impacts or obstacles to implementation of alternative energy sources or actions are discussed in Appendix C and Section II.A.7. Impact factors associated with likely alternative energy sources (Table II.B.7) include such items as increased air pollutant emissions (e.g., SO2 and particulates), disruption of land, elimination of wildlife habitats, increased water pollution (surface and ground) and waste disposal.

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